

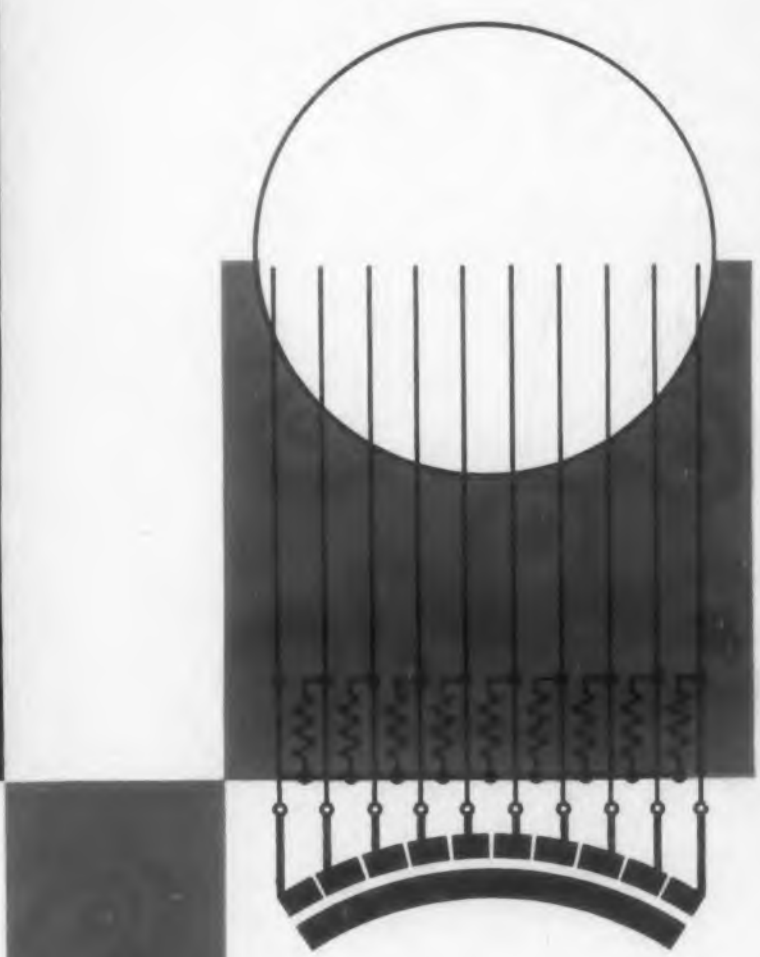
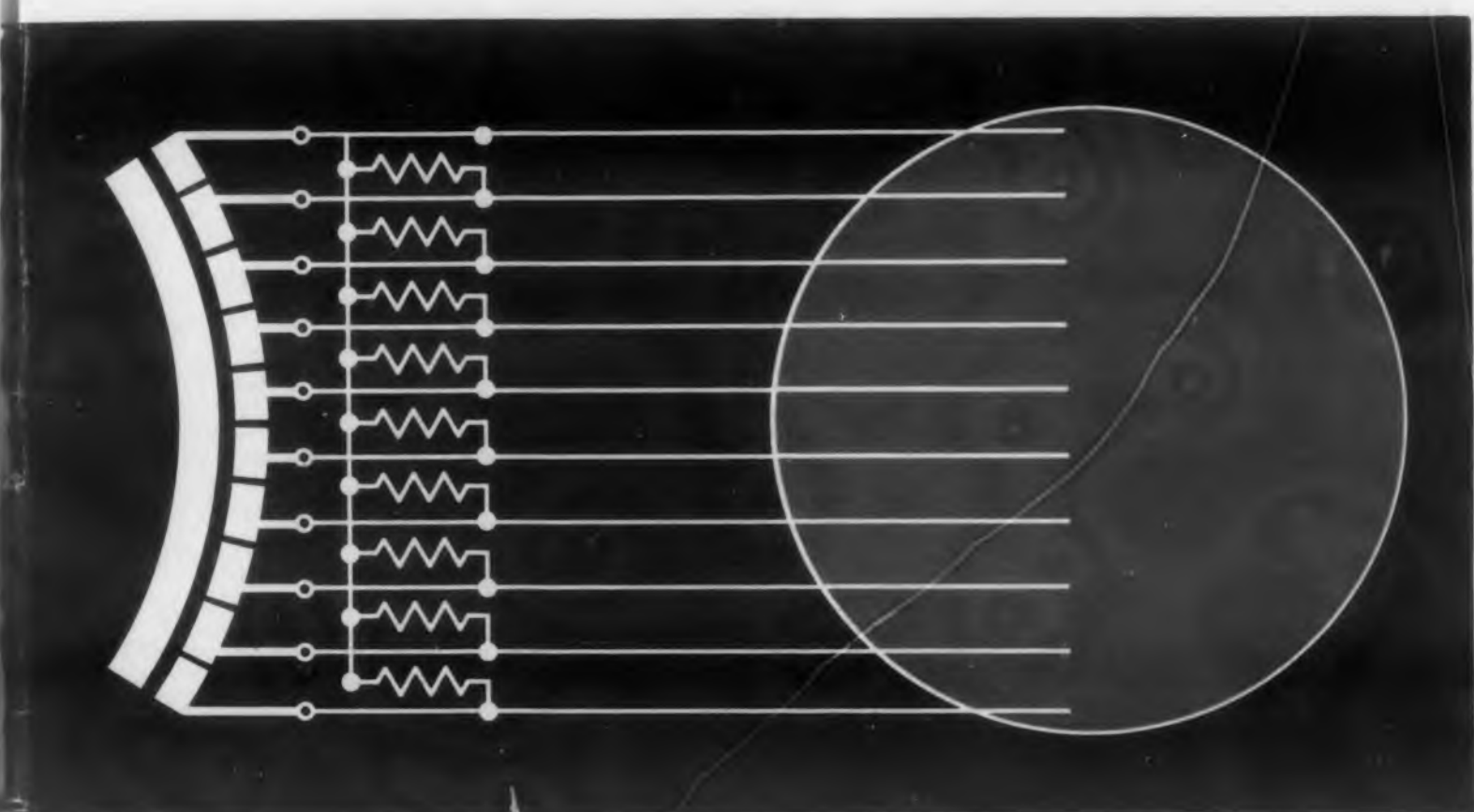
ELECTRONIC DESIGN

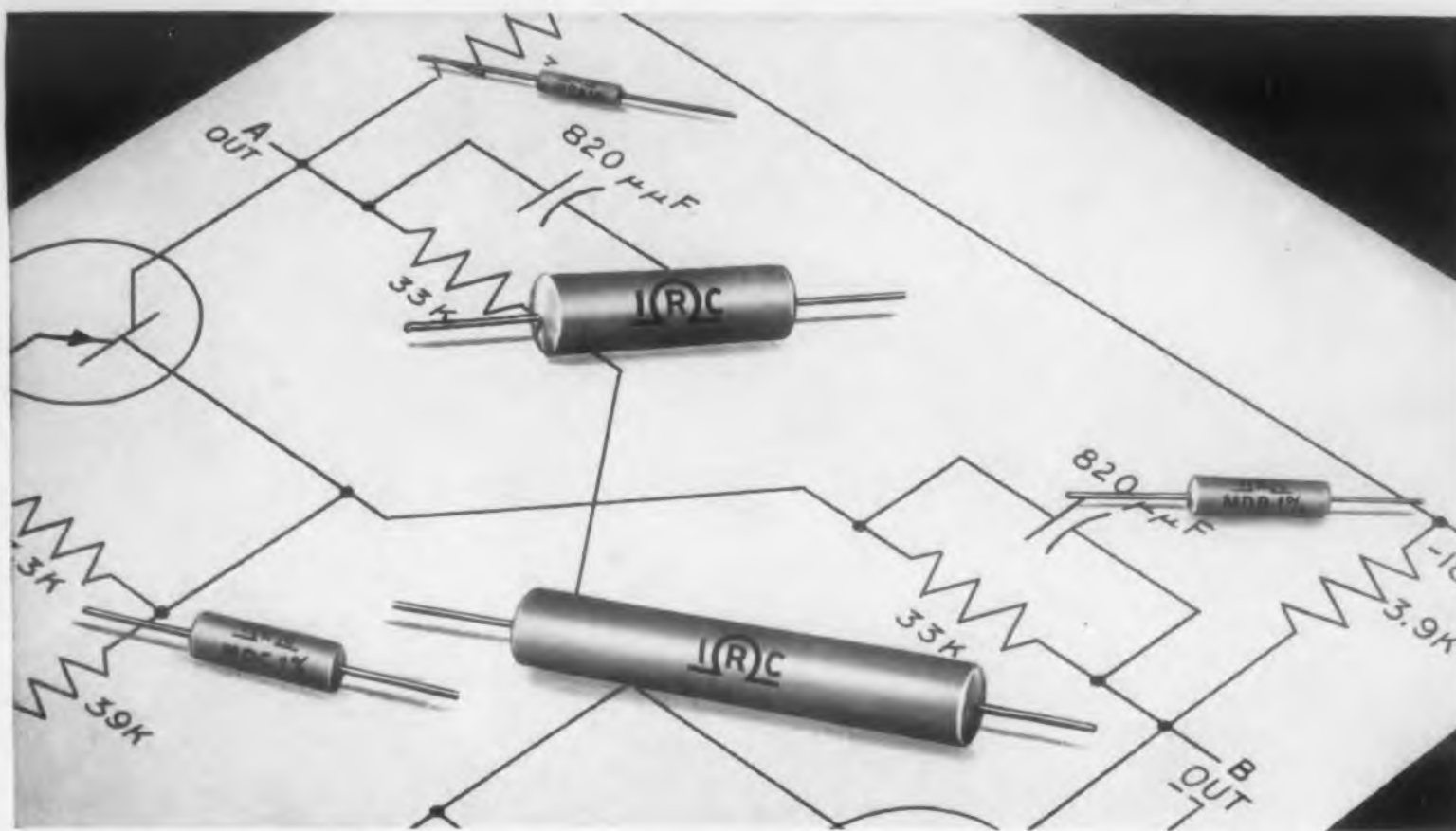
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THE OFFICE OF
NAVY RECORDS
AND COMMUNICATIONS
JUL 21 1956





WHY SPECIFY 1 WATT WHEN YOU NEED 1/2 WATT?

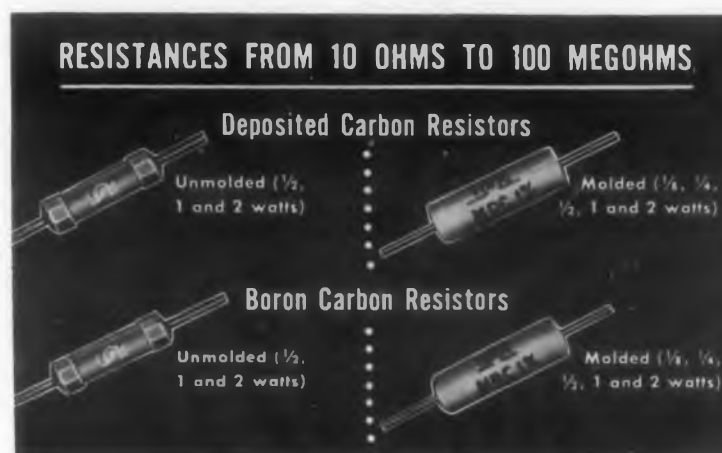
Use **IRC**® Deposited and Boron Carbon Resistors

Now you can save two ways whenever circuits call for high precision resistors with long term stability and built-in overload protection. IRC Molded Deposited and Boron Carbon Resistors can withstand substantial overloads for considerable periods without exceeding tolerances. This means savings in *space, weight and cost!* The conservative rating of these units assures you of reliability—no need to specify larger resistors.

Announcing a new high-range process featuring stability! With a unit as small as IRC's 1/2 watt Deposited Carbon Resistor, you can cover a resistance range from 10 ohms up to 25 megohms. With IRC's 2 watt resistor, you can go from 15 ohms as high as 100 megohms.

If you want the same span of resistance ranges, plus better load life characteristics and greater

resistance to moisture and mechanical damage, you can specify *molded* types for automation equipment in sizes that meet MIL specs. These molded units are now available in 5 ratings—1/8 watt, 1/4 watt, 1/2 watt, 1 watt, and 2 watts. For extremely low temperature coefficients, use IRC Boron Carbon Resistors. Send the coupon today.



Insulated Composition Resistors • Deposited and Boron Carbon Resistors • Power Resistors • Voltmeter Multipliers • Ultra HF and Hi-Voltage Resistors.

Wherever the Circuit Says

Low Voltage Wire Wounds • Resistance Strips and Discs • Selenium Rectifiers and Diodes • Hermetic Sealing Terminals • Insulated Chokes • Precision Wire Wounds.



INTERNATIONAL RESISTANCE CO.

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In Canada: International Resistance Co., Ltd., Toronto, Licensee

Send bulletins describing Deposited Carbons Molded Deposited Carbons Boron Carbons Molded Boron Carbons.

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ELECTRONIC DESIGN is published semi-monthly by Hayden Publishing Company, Inc., 19 E. 62nd Street, New York 21, N. Y., T. Richard Gascoigne, President; James S. Mulholland, Jr., Vice-President & Treasurer and David B. Landis, Secretary. Printed at Hildreth Press, Bristol, Conn. Acceptance under section 34.64 P. L. & R. authorized. Copyright 1956 Hayden Publishing Company, Inc., 27,000 Copies this issue.



*for an entirely
new range of
time delays*

Delay Intervals:

$\frac{1}{10}$ to 5
seconds

Recovery Rate:

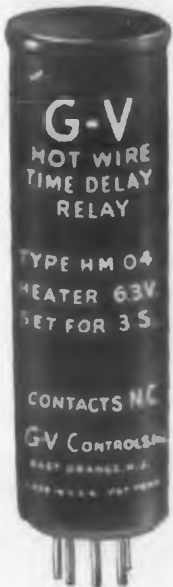
extremely
rapid



*specify
sturdy, dependable,
application-tested*

G-V Hot Wire Time Delay Relays

SERIES H



WRITE for Publication No.35—
complete engineering
data and drawings.

Designed for delay intervals which are longer than those produced by magnetic relays and shorter than can be produced by the usual types of thermal relays, these G-V Hot Wire Time Delay Relays make possible many simplified, lightened and improved designs.

How They Operate: G-V Series H Time Delay Relays employ a group of nickel-chromium alloy wires, 8 to 20 strands electrically in series and mechanically in parallel, as the actuating element. A mechanism holds these wires under tension and when the energizing current passes through these wires, heating them and causing elongation, the mechanism multiplies this and moves the contacts into or out of engagement.

Over two years of successful field service in electronic, aeronautical and industrial equipment prove these new G-V relays to be dependable, efficient and accurate.

ADJUSTABLE DELAY even though hermetically sealed
DC or AC of any frequency for energization

SMALL AND LIGHT. $\frac{3}{4}$ " diameter, $2\frac{3}{8}$ " length. Weight: 1 oz.

WIDE AMBIENT RANGE compensated from -70°C to 100°C or higher

CONTINUOUS ENERGIZATION without damage

AVAILABLE in 7-pin Plug-in and Flanged designs



G-V CONTROLS INC.

18 Hollywood Plaza, East Orange, New Jersey

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OUR MILLIONTH FILTER SHIPPED THIS YEAR...

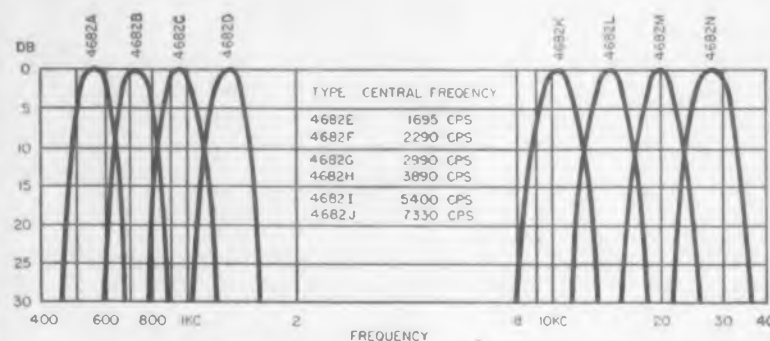
FILTERS

FOR EVERY APPLICATION



TELEMETERING FILTERS

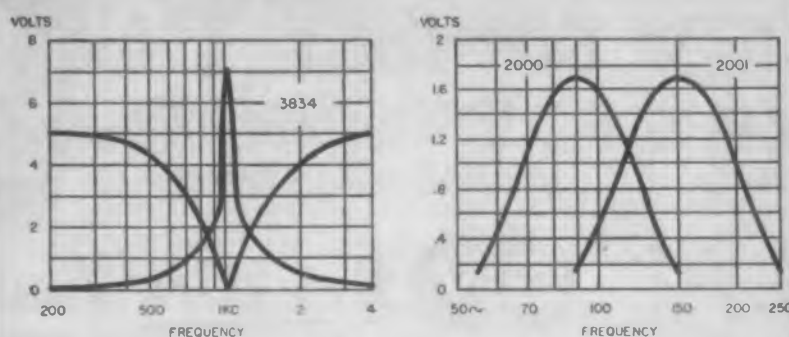
UTC manufactures a wide variety of band pass filters for multi-channel telemetering. Illustrated are a group of filters supplied for 400 cycle to 40 KC service. Miniaturized units have been made for many applications. For example a group of 4 cubic inch units which provide 50 channels between 4 KC and 100 KC.



Dimensions:
(4682A) 1½ x 2 x 4"



Dimensions:
(3834) 1¼ x 1¾ x 2-3/16"
(2000, 1) 1¼ x 1¾ x 1½"



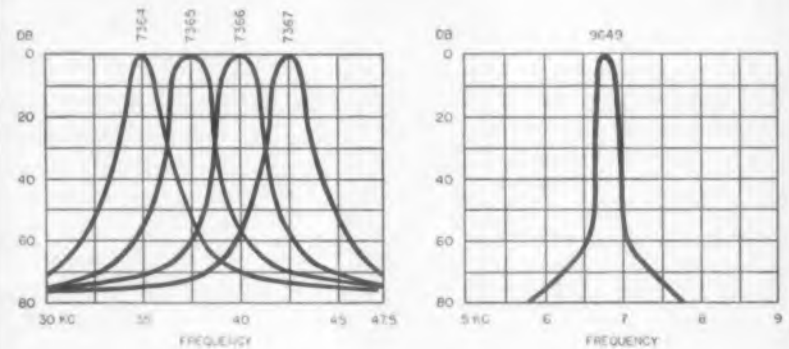
AIRCRAFT FILTERS

UTC has produced the bulk of filters used in aircraft equipment for over a decade. The curve at the left is that of a miniaturized (1020 cycles) range filter providing high attenuation between voice and range frequencies.

Curves at the right are that of our miniaturized 90 and 150 cycle filters for glide path systems.

CARRIER FILTERS

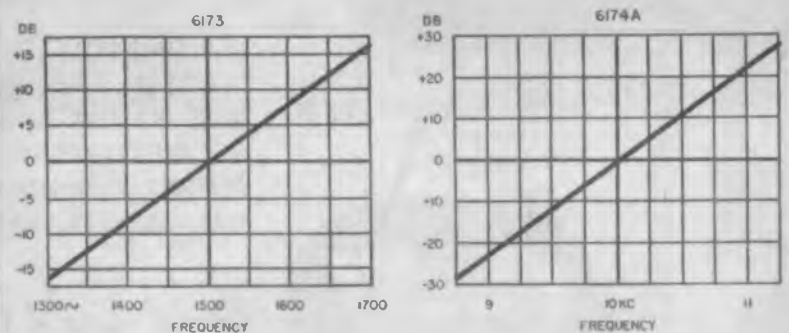
A wide variety of carrier filters are available for specific applications. This type of tone channel filter can be supplied in a varied range of band widths and attenuations. The curves shown are typical units.



Dimensions:
(7364 series) 1½ x 1½ x 2¼"
(9649) 1½ x 2 x 4"

DISCRIMINATORS

These high Q discriminators provide exceptional amplification and linearity. Typical characteristics available are illustrated by the low and higher frequency curves shown.



Dimensions:
(6173) 1-1/16 x 1¾ x 3"
(6174A) 1 x 1¾ x 2¼"

Editorial

Retirement of Engineers

Each year the electronic industries lose engineers for various reasons. Many of these reasons are sound or unavoidable.

What we can't understand is the case where a man of 30 or more years of experience, is forced to leave engineering because of the compulsory retirement policy of his company. We know that there are perfectly sound reasons for compulsory retirement.

None of these reasons, however, are sufficient justification for tossing years of engineering experience out the window, especially when the need for technical men is so urgent. Surely, ways could be found to make use of this experience.

For one thing, the retired engineer could be employed on a part-time basis or in some consulting capacity. He might come in later and leave earlier, and possibly work fewer days than he did before. As for consulting work, there are always dozens of problems around that no one seems to have time to work on.

Another suggestion is that retired engineers take on light teaching loads at nearby engineering schools. Students could benefit a lot by contact with really experienced engineers.

Writing books, articles, etc. represent another form of activity that requires the time and background which older engineers have. This is one way of passing on the knowledge gained through years of experience.

Many of these ideas are being carried out. More are needed. No engineer who is capable and willing should be denied the opportunity of contributing to the growth of his profession and his industry—even though he is 65 years old.

Article Index

In the center section of this issue we have included an index to the articles published in ELECTRONIC DESIGN for the first six months of this year.

We welcome readers' comments and suggestions on the arrangement, contents, appearance, etc. of the index. Additional copies may be obtained by using the Readers' Service Card and circling number 305.

For full data on stock UTC transformers, reactors, filters, and high Q coils, write for Catalog A.

UNITED TRANSFORMER CO.

150 Varick Street, New York 13, N. Y. EXPORT DIVISION: 13 E. 40th St., New York 16, N. Y. CABLES: "ARLAB" ◀ CIRCLE 3 ON READER-SERVICE CARD

Electronic News

For more information on developments described in "Engineering Review", write directly to the address given in the individual item.

Biggest Analog Computer West of the Mississippi . . . The biggest analog computer west of the Mississippi will be built for the Allison Div. of General Motors. When completed, it will stand 6 feet high and span a width of nearly 60 feet. The mass of electronic equipment, grouped in 29 metal cabinets, will weigh some 10 tons.

Built by the Berkeley Div. of Beckman Instruments, Inc., 2200 Wright Ave., Richmond, Calif., the computer will be used by Allison engineers to simulate jet engines electronically. With the instrument, designers can picture an engine in action under varying conditions even before it has been built.

Capable of solving with lightning swiftness the high order differential equations involved in design work, the computer will substantially speed the development of engines of the future. Outstanding feature of the computer are its 12 automatically set "map readers" to investigate function contours made up of two independent variables. Their basic components include 80 function generators—five times the number used in previous analog computers.

Technique Resembles Deliberative Human Judgment . . . Broad patents have been applied for on a small black box having man-like powers of deliberative judgment. The device follows precise rules of logic in reasoning whether to accept, reject, or demand confirmation of data fed into it.

Developed primarily for airborne applications, by Lear, Inc., Santa Monica, Calif., the system provides basic new methods of discriminating automatically between data from any two information sources. It does this through continuous electronic application of the laws of probability and error distribution, in order to deduce from two sets of data, each having known chances of error, intelligence more accurate than either conventional source could possibly provide.

The system is called SCAN, meaning Self-Correcting Automatic Navigator. It will enable an aircraft to fly straight to its target over enemy territory despite any attempts at electronic jamming, and

without disclosing its presence by emitting any radiation. This technique will make use of reflected v-h-f signals far beyond the line of sight to which such signals are normally confined, and thus can penetrate through mountainous terrain at low levels avoiding radar detection. Only those signals are accepted which fall within the error limits of the system.

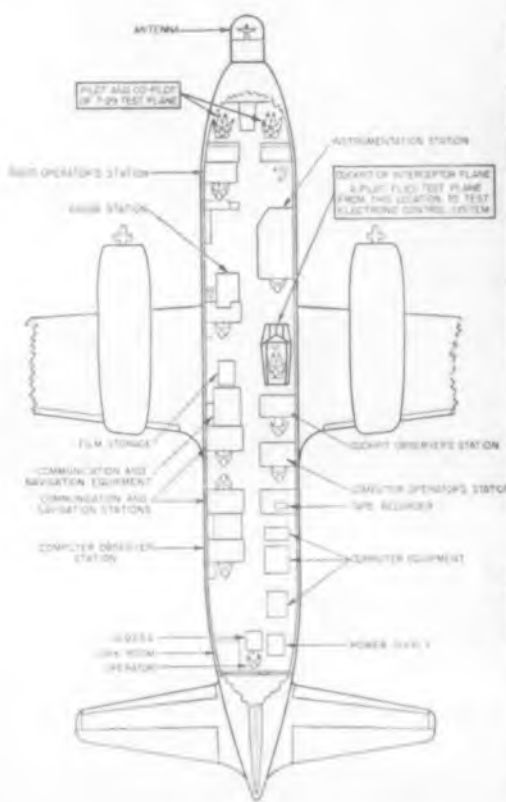
Higher Electronic Manufacturers Failures This Year . . . Business failures of manufacturers of radio-TV-electronic equipments and components during the year ending April 30, 1956 rose slightly in number from the total reached in the corresponding 1955 period.

During the year ending in April, 29 manufacturers of electronic equipment or products failed compared with 26 in the previous period. The bulk of the troubled companies are continuing in business under the supervision of creditor's committees, although nine of them have gone out of business completely with little or no recovery to creditors.

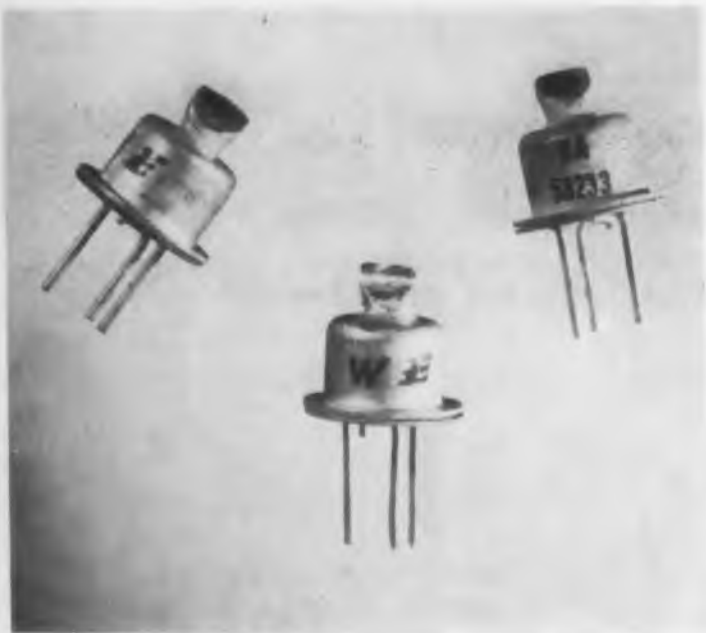
By type of product manufactured the companies were classified as follows: 17 were producers of components; 8 were manufacturers of electronic equipment; 2 manufactured phonographs; 1 produced recorders; and 1 manufactured electronic organs.

Plane Within Plane Tests Control System For Jet Interceptors . . . An advanced electronic control system is being tested for a jet all-weather interceptor plane by installing a cockpit and entire electronic control system in the main cabin of a T-29 military adaptation of the Convair 240 airliner.

Developed by Hughes Aircraft Co., Culver City, Calif., it operates in this manner. The regular pilot takes the T-28 aloft, then transfers control to a test pilot in the cabin cockpit. This "back-seat" pilot flies the plane as though it were a jet interceptor, operating its electronic "seek, find and kill" system while scientists and engineers check the performance of the system and a psychologist checks the performance of the pilot.



In a cockpit installed in the main cabin of a T-29 airliner, a second pilot takes over control of the plane once the regular pilot has taken it aloft. At left is a layout of the flying laboratory.



Diffused Base Germanium Transistors . . . Urgent military demands for diffused base germanium transistors have called for the Western Electric Co. to undertake immediate manufacture of these units for exploratory development work. Initial production facilities were set up in the Company's Laureldale plant and the manufacturing program will be stepped up to meet military requirements as they develop.

These new transistors have a high frequency performance surpassing that of any other transistor presently available. They are particularly suited to v-h-f oscillator, medium power i-f and broad band video amplifier applications. Representative units which were recently described at a symposium held by Bell Telephone Laboratories, have provided 50mw output as oscillators at 200Mc. Other units of this type as video amplifiers have given about 19db gain per stage with an 8Mc bandwidth.

Typical units produced at present have an alpha frequency-cutoff median value of approximately 400Mc with some units showing alpha frequency-cutoff in excess of 600Mc. Power dissipation is 150mw maximum at 25°C with an appropriate heat sink. Common emitter short circuit current gain at 50Mc is 12db minimum.

First Hi-Fi Tape Recorder With Transistors And Printed Circuitry . . . A compact, professional quality hi-fi magnetic tape recorder has been developed utilizing transistors and printed circuitry—the first of its kind.

The instrument, developed by Radio Corp. of America, is designed for plug-in use in home assembled hi-fi music systems and industrial sound systems.

Designated the SRT-2, the recorder covers the audible range from 30 to 15,000 cycles, utilizes all types of standard magnetic tapes, in 5" and 7" reels

and can be installed in either vertical or horizontal position.

Scheduled for availability early this fall, the recorder will be retailed through distributors at a suggested consumer price of \$495.

Research Reactor for German University . . . A contract was signed recently to install at a University the first reactor in free Europe for training engineering students in nuclear science.

The contract was signed by AMF Atomics, Inc., subsidiary of American Machine and Foundry Co., and the Federal Republic of Germany's State of Bavaria, calling for the construction of the reactor at Munich's Technische Hochschule.

The installation of the reactor and the development of the nuclear research center which it will serve will be a significant milestone in free Europe's peaceful atom program. The specialized training the reactor will make possible will create a new supply of nuclear scientists which German industries will have access to in implementing their own nuclear research program.



Machinability Computer . . . By applying old machining standards, it would have taken 244 minutes to machine a specific part in the Chicago plant of Scully-Jones and Co. Today, with new standards furnished by this machinability computer, developed by Carboloy Department of General Electric Co., Detroit, Mich., the company is machining the same part in 166.20 minutes, or 77.80 minutes less time per part. This is a saving of roughly 17 hours on 13 parts.



Vapor Container Shell . . . Welders put finishing touches on a steel shell for the vapor container of the Army Package Power Reactor, one of the nation's first atomic generating plants. The container is 64' high and 36' in diameter with walls of 7/8" steel plate and that will be reinforced with 2' of concrete. It is designed to withstand maximum pressure which could be exerted should an incident occur. The APPR, which ALCO Products, Inc. Schenectady, N. Y., is building at Fort Belvoir, Va., for the AEC, is expected to be in operation early in 1957.

General Dynamics Builds Controls For Largest Super-Sonic Wind Tunnel . . . The U. S. Army Corps of Engineers has awarded General Dynamics Corp. a contract for more than \$2,500,000 to provide the electronic equipment for controlling the flow of air in what will be the world's largest super-sonic wind tunnel. The tunnel is now under construction at the Air Force's Arnold Engineering Development Center at Tullahoma, Tenn.

Dynamics' Electric Boat Div., in Groton, Conn., has overall responsibility, and will execute the contract in partnership with Stromberg-Carlson. General Dynamics' part of the contract is to design and construct a control system for the nozzle of flexible ducting which will regulate the flow of high velocity air through the actual testing chamber. The portion of the contract which will be carried out by Stromberg-Carlson calls for creation of a digital computer system for automatically controlling the shape of the nozzle by electric means.

New 16" Sendzimir Cold Rolling Mill . . . A new 16" Sendzimir cold-rolling mill, the largest of its kind in the spring industry and the first designed especially to use a water-emulsifiable mineral oil as coolant and lubricant for the rolls, was recently placed in full scale operation.

Designed by the Armzen Co., Waterbury, Conn., and built by the Waterbury Farrel Foundry & Machine Co., also of Waterbury, the mill is in operation at the Forestville, Conn., plant of Associated Spring Corp.'s Wallace Barnes Steel Div. It is capable of rolling strip steel up to 13" wide, and will increase by up to 50% the steel-rolling capacity of the plant's facilities. The mill will make it possible to roll much thinner gages of steel than was possible before.

It also provides, by automatic controls, greater accuracy in the gage of the steel rolled, and much greater uniformity of thickness across the width of the strip as well as along its length.



The 16" mill is capable of rolling strip steel up to 13" wide.



Factory: Huntington, Indiana



Factories:
Huntington, Indiana

TRU-OHM PRODUCTS, division of Model Engineering & Mfg. Co., Inc., General Sales Office: 2800 N. Milwaukee Ave., Chicago 18, Ill.

Vol. 80,000,000

1955-56

No. 80,000,000

80 MILLION SOLD!

TRU-OHM is Now the World's Largest Producer of Wire-Wound Resistors!



Special size resistors: Tru-Ohm's highly skilled factory trained technicians turn out large varieties of special resistors. Complete data of these special size resistors is available.



Complete line of power rheostats . . . of finest quality with UL approval; variety from 25 watts up.

High Quality, Speedy Delivery Sets Record

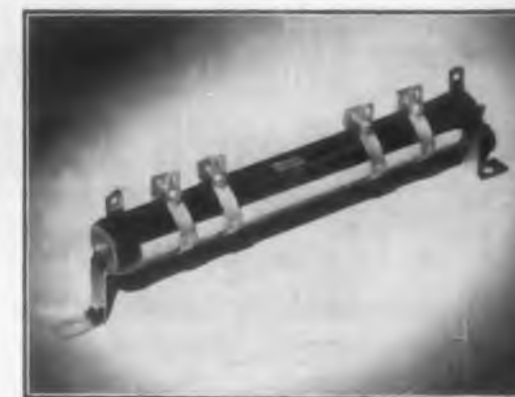
Over 50,000 square feet of the most modern manufacturing facilities, including a brand new furnace, enable volume production . . . assure faster delivery, finer quality, better prices. And TRU-OHM EXPEDITES FOR YOU . . . ships on time.

Inquiries Invited. You can get the complete story of Tru-Ohm's tremendous growth and why, by writing to 2800 N. Milwaukee Ave., Chicago 18. Let Tru-Ohm's experts solve your resistor and rheostat needs.

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Chicago . . . From Tru-Ohm's general sales office. Since starting just a few short years ago, TRU-OHM PRODUCTS has grown phenomenally to ten times its original capacity. Having just produced its 80,000,000th wire-wound resistor, Tru-Ohm is now the world's largest growing and largest producers of wire-wound resistors.

Chicago . . . From Tru-Ohm's general sales office. Since starting just a few short years ago, TRU-OHM PRODUCTS has grown phenomenally to ten times its original capacity. Having just produced its 80,000,000th wire-wound resistor, Tru-Ohm is now the world's largest growing and largest producers of wire-wound resistors.



Resistor No. 80,000,000. One of many wire-wound resistors which are turned out by the thousands daily.

For Original Equipment or Replacement Needs

A complete line of resistors as well as a complete line of power rheostats are now produced for the finest industrial manufacturers in the world . . . for replacement applications . . . sold through parts jobbers.



Hand holds Eimac 1K015CA local oscillator C Band Klystron, 5300-6000 MC

New EIMAC Microwave Center Opens at Salt Lake City, Utah for Research and Production of Local Oscillator Klystrons

A new microwave facility for Eimac local oscillator reflex klystron research and production is opening this month at our Salt Lake City, Utah plant. For 13 of the 22 year history of Eitel-McCullough, Inc., the production excellence of the Salt Lake City installation has been instrumental in establishing Eimac as the world's largest manufacturer of transmitting tubes.

And now this production skill and decentralized location 600 miles from the Pacific Coast combines with research specialization to offer ready made advantages to users of reflex klystrons. Investigate these Eimac advantages to fulfill your requirements for development or production of rugged local oscillator microwave klystrons.



EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
The World's Largest Manufacturer of Transmitting Tubes

CIRCLE 5 ON READER-SERVICE CARD FOR MORE INFORMATION



Electronic Brain Supply Sargeant

The IBM Type 702 giant brain is installed at the Navy's Aviation Supply Office in Philadelphia, where it is used to provide the thousands of Naval aircraft based around the globe with parts and equipment they need. This one reel of tape, shown here, contains over 5,000,000 digits and letters of inventory information and is read at the rate of 15,000 characters a second.

Women Will Double Engineers Supply in Next Century . . . The possibility of doubling the supply of engineers and scientists by including more women in the profession was underscored recently by Morris D. Hooven, president of the American Institute of Electrical Engineers.

Mr. Hooven has gone even a step further by envisioning a woman as president of the Institute a century hence. Present membership now consists of more than 49,000—most of them males.

These interesting prognostications are contained in a letter by Mr. Hooven to the president of the Institute in 2055, which has been placed in the "Vault for the Future" at the George Washington Univ., Washington, D.C.

Scale Model of SAGE System

Low-flying aircraft which come in under the beam of the long-range search radar of the SAGE system are detected by gap-filler installations. This model of an unattended low-altitude radar is complete, even to the wire fence around the installation. The scale model was made by Atkins & Merrill, Inc., South Sudbury, Mass.



ELECTRONIC DESIGN • July 15, 1956



Force Transducer

This specially built SR-4 load cell of 250,000 lb capacity, 22" high and 12" diameter will be used by a large aircraft company to measure rocket thrust. Developed by Baldwin-Lima-Hamilton Corp., Philadelphia, Pa., the transducer incorporates two independent load measuring resistance wire strain gage bridge circuits for instrumentation.

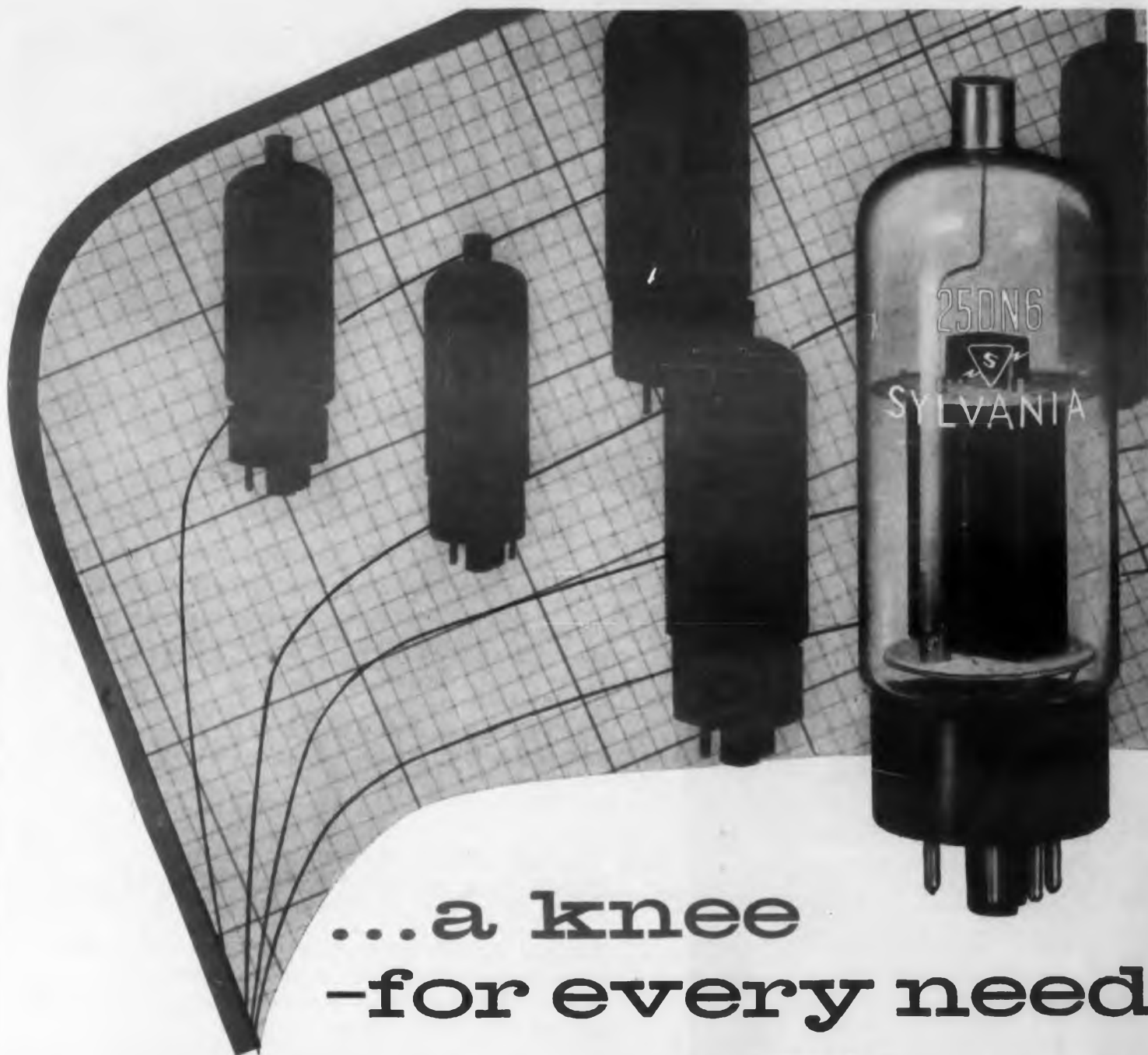
Storm-Detection Radar System . . . Radio Corp. of America recently exhibited a weather-detection radar system which enables pilots to see storms and cloud formations up to 150 miles ahead.

Shown at the opening of the U.S. Weather Bureau Show, it featured a model of the nose and cockpit of an aircraft, with the antenna of the weather radar system installed in the nose, and a radarscope, with storm picture, mounted in the cockpit. The exhibit enabled visitors to observe how the antenna picks up storm formations ahead to provide the pilot with early storm warnings.

The system has already been purchased for use in the airfleets of five U.S. and four foreign commercial airline companies, and in numerous business airplanes and other types of private aircraft.

Air Traffic Control System

Volscan, a new air traffic control system, is designed to convert a confusion of randomly arriving aircraft into an orderly, safe procession. It is a combination of radar and computers and can handle as many as 120 landings per hour. The first Volscan system, a development of Crosley Govt. Products Div., Avco Mfg. Corp., Evendale, Ohio, will be delivered to the Air Force for flight evaluation.



...a knee
-for every need
-including low B+ deflection



Peak plate currents are checked in production on universal dynamic testing equipment built by Sylvania engineers.

For all your TV designs, Sylvania offers a complete line of deflection amplifier tubes with proper plate knee characteristics to meet every deflection need.

And Sylvania offers you the Sylvania-originated type 25DN6 designed to deliver high peak currents for proper deflection in low B+TV designs.

All Sylvania deflection tube types are tested under an exhaustive dynamic testing program. Critical parameters are

checked 100% in production and double checked in destructive life tests in universal equipment specially designed by Sylvania engineers to simulate circuit conditions existing in the modern television receiver.

Whatever your needs, 70°, 90° or 110°, Sylvania can fill your vertical and horizontal deflection socket—backed by exhaustive reliability tests under actual operating conditions.

 **.SYLVANIA®**

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In Canada: Sylvania Electric (Canada) Ltd.
University Tower Bldg., Montreal

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NEW WESTINGHOUSE
HIGH-POWER
SILICON RECTIFIER



*475 amperes d-c . . .
300 volts PIV*

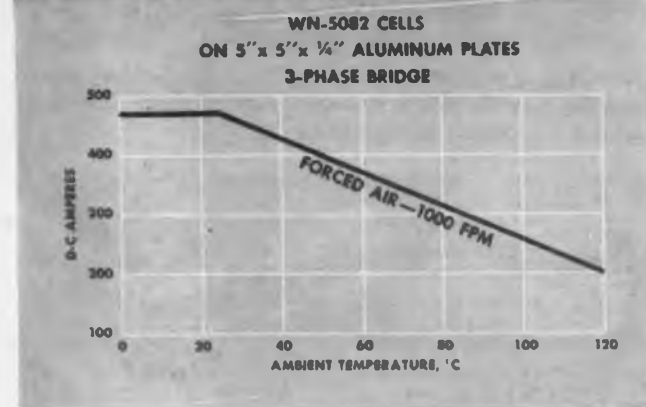
Highest power silicon rectifying cell commercially available . . . that's the Westinghouse WN-5082!

Ambient temperatures present no heat problems for these silicon cells—units operate in temperatures up to 175° C. Curve below shows forced air-cooled, three-phase bridge ratings.

This diode is ideally suited for railway, elevator, arc welder, battery charger and other industrial high-power applications.

Production quantities are available immediately. For more information on the WN-5082, or any other silicon rectifier requirements, regardless of voltage and current, call your nearest Westinghouse apparatus sales office. Or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-09004

WATCH WESTINGHOUSE!
WHERE **BIG** THINGS ARE HAPPENING **TODAY!**



CIRCLE 7 ON READER-SERVICE CARD FOR MORE INFORMATION



Infrared Oven Paint Dryer

The fast-drying feature of infrared oven is used by Westinghouse Electric Corp. to temporarily set paint on washing machine spinners and roaster pans in their Columbus, Ohio, plant. The oven installation, by the Fostoria Pressed Steel Corp., Fostoria, Ohio, quickly sets the frit to prevent running into corners and joints of the pieces.

New Machine Prints 360 Radio or TV Units Per Hour . . . A new machine has been developed that ejects completely assembled and soldered printed circuit TV or radio units, consisting of 50 to 100 component parts each, at the rate of 360 units per hour, without the aid of a human hand.

The machine is equipped with multiple parts inserters (on which patents are pending) that automatically place all of each variety of part in single stations of the machine requiring no crimping and no flux application. Finished units are automatically ejected and bare panels injected from a multi-sided turret.

Magazines which feed parts to the inserters are of such capacity as to require infrequent reloading, the machine running hour after hour without attention. The machine was developed by Equip-a-matic Engineering Corp., Riverside, Ill.

ASTE Plans 5-Year Technical Book Expansion Program . . . More and better technical books for engineers in the tooling and manufacturing field are on the way as part of a new 5-year book publishing expansion program recently announced by the American Society of Tool Engineers.

The plans call for publication of at least two additional major handbooks in the production and manufacturing field, as well as the undertaking of a 3-year revision of the Tool Engineer handbook, which has sold in excess of 75,000 copies all over the world.

To accomplish the work, a field book editor is being organized in each of the Society's 132-chapters. Each group will assist in the authoring and reviewing of assigned book sections. Eventual plans call for more than 800 authors and reviews, each a recognized industry expert in some particular field.



Avionic Operational Equipment

This view of the outside of the three vans comprises the new MSQ-1A Close Support Control Set built by Reeves Instrument Corp., a subsidiary of Dynamics Corp. of America, at a cost of approximately \$40,000,000. The system consists of radar, computer, and communications vans capable of being transported from place to place in support of tactical operations under combat conditions.

Electronics May Provide Guided Missile Defense

... According to Dr. Allen B. Du Mont, when a defense against nuclear missiles is developed, electronics will play a major role in such a system.

In discussing particular types of electronic devices at the Pacific General Meeting of the AIEE, Dr. Du Mont said that the cathode-ray oscillograph or scope is the key to the electronic age. He said, "there isn't any other device in existence that can accurately measure the kind of high-speed phenomena found in electronics. I feel safe in predicting that the writing speed of the beam of an oscillograph can be increased in the near future to a speed faster than the speed of light. This will make possible the measurement of such extremely high-speed phenomena as nuclear reaction and radioactive scintillation."

Air-to-Air Guided Missile

Close-up view of U.S. Navy's air-to-air guided missile, the supersonic Sparrow 1, now combat-ready with the Fleet. The new air weapon, developed by Sperry Gyroscope Co., Great Neck, N. Y., is shown here on the wing of a Chance Vought F7V-3M "Cutlass", as presently deployed on carriers. Deadly accuracy has been shown by many practice launchings against drone targets, high speed jet aircraft, and against other missiles.



DOW CORNING
CORPORATION

Silicone News

FOR DESIGN ENGINEERS



3 Year Test Proves Superiority Of Silastic Gaskets On Steam Cookers

Despite prolonged exposure to steam and pressure, Silastic[®], Dow Corning's silicone rubber, keeps its shape, remains resilient, maintains an efficient seal. That's why the Cleveland Range Co. uses gaskets made from Silastic for sealing the doors of its well-known line of Steam-Chef Steam Cookers.

The change from organic rubber to Silastic was made after a three year field test program which proved the superiority of silicone rubber gaskets. Molded by the Ohio Rubber Co., these test gaskets were installed on Cleveland Range units in commercial and institutional kitchens throughout the midwest.

Restaurant managers were surprised to see at the end of six months, the average life of organic rubber gaskets, that the Silastic gaskets still looked as good and sealed as efficiently as when new. Time and rugged service apparently had little or no effect on the silicone rubber gaskets. Particularly impressive was the fact that Silastic did not impart off-flavor taste to foods during cooking.

The above photograph of a Steam-Chef Cooker in the Mill Restaurant, Cleveland, Ohio, shows the type of evidence compiled during this test. The organic rubber gasket on lower door, hardened and flattened by heat and pressure, has completely lost its sealing efficiency. The narrow Silastic gasket on the top door is as effective as new after the same length of service. No. 91

* T. M. REG. U. S. PAT. OFF.

Silicone-Glass Laminates for electrical and mechanical applications are described in new brochure which illustrates parts used in typical industrial applications. Also lists engineering information on properties of silicone-glass laminates and lists fabricators. No. 91

Canned Motor-Pump Handles Radioactive Liquid Coolants

Utilizing the thermal stability of electrical insulation made with Dow Corning silicones, Westinghouse designers have developed a canned motor-pump that answers the Atomic Energy Commission's need for a way to circulate radioactive liquid coolants at temperatures up to 650 F in hermetically sealed hydraulic systems.

Used in the primary coolant system of nuclear reactors, both the pump impeller and its electric drive motor are encased in a single pressure-tight vessel. The hot, radioactive fluid circulates around the bearings, rotor and stator of the silicone insulated drive motor.

Stainless steel jacketing protects the ends and outside diameter of the stator windings. A thin, leak-tight, nickel-alloy cylinder or "can" lines the inner bore of



the stator. The outer surface of the rotor is similarly canned.

Silicone-insulated canned motor-pumps of this design are now available in capacities from 5 to 17,000 gpm. They can handle high temperature liquids at system pressures up to 2500 psi.

According to Westinghouse, these pumps are also used in steam systems where controlled or forced circulation is required, and in certain process applications of the chemical and petroleum industries. Special canned motor-pumps are even available for pumping molten metal at temperatures as high as 1000 F. No. 93

New booklet on Silicone Based Paints describes and illustrates how these heat, moisture, weather and oxidation resistant coatings improve product finishing and reduce maintenance costs on equipment ranging from industrial furnaces and exhaust stacks to domestic space heaters and garbage incinerators. Also explains difference between the straight silicone and modified silicone paints now available from more than 50 formulators listed as sources of supply. No. 94

Liquid Springs Use Silicone Fluid For Greater Efficiency

With compressibility of 9 to 10% at 20,000 psi compared to 6 or 6½% for mineral base oils, silicone fluids are specified by designers at Wales Strippit Corporation as the compressible media for their entire line of liquid filled "Hydra Springs."

Thermal stability and remarkably flat viscosity temperature slopes were also important considerations which led to the use of Dow Corning silicone fluids in these precision hydraulic devices. Most Hydra Springs employ Dow Corning 200 Fluid. A few, requiring special springing characteristics, utilize other Dow Corning silicone fluids.



Liquid spring at right delivers same amount of force as the large cumbersome metal coil spring.

Providing forces 3 to 6 times greater than coil springs of equal size, Hydra Springs have proved highly efficient and successful in metal working dies, perforating equipment, testing equipment, ordnance devices, specialized machinery. No. 92

Design Edition 22

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Midland, Michigan

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CIRCLE 8 ON READER-SERVICE CARD FOR MORE INFORMATION

write for

DAVEN'S NEW ENCAPSULATED RESISTOR CATALOG

*... a 12-page catalog on Daven's complete
encapsulated wire wound line*

Based on the results of an intensive research development program designed to improve encapsulated wire wound resistor performance, advance miniaturization, and reduce cost, the new DAVEN catalog places vitally important data at the command of the engineer and will prove to be an indispensable reference guide.

Newly developed products, new plastic formulations, new encapsulating techniques, in addition to many, many other design features, are embodied in DAVEN's new line of encapsulated resistors and are presented, in detail, in this new reference catalog.

Briefly, the catalog includes: temperature sensitive resistors; new products: card type resistors—miniature DC voltage dividers and DC networks—"toothpick" resistors; miniature resistors; sub-miniature resistors; axial lead types; lug types; MIL-TYPES—in short, all of DAVEN's new contributions to the field of encapsulated resistors.

Write, Today, For Your
Copy of this 12-page
supplement to Daven's
Precision Wire Wound
Resistor Catalog!

THE **DAVEN** CO.

530 West Mt. Pleasant Ave.
Livingston, N. J.



CIRCLE 9 ON READER-SERVICE CARD FOR MORE INFORMATION



Wind Tunnel Tests On TV

Three RCA industrial TV camera chains and four 24" TV monitors are enabling engineers at the Lewis Flight Propulsion Laboratory, Cleveland, Ohio, to remotely view the performance of aircraft models and engines in wind tunnel tests. Research personnel in the control room operate and observe the performance of a model undergoing tests in a wind tunnel 250 feet away.

Largest Aluminum Wound Transformer . . . The largest aluminum wound transformer ever made was recently installed at the Kitimat, British Columbia, smelter of the Aluminium Company of Canada, a subsidiary of Aluminium Ltd.

Made by the English Electric Co., at St. Catharines, Ont., the 70,000kva, 3-phase, 60cy oil-filled power transformer features high and low voltage coils wound with aluminum conductor (about 40 miles of it); a tubular and rectangular aluminum bus bar system; internal aluminum connections; and finned aluminum tubing cooling units.

In operation, the windings are cooled by circulating the oil through five heat exchangers distributed about the periphery of the tank. These exchangers incorporate an integrally mounted oil forcing pump, designed and built especially for this application. An extruded aluminum fin tube is used in a three pass combination and heat is carried away from the fins by air blown over the tubes by motor-driven fans.

A sixth cooler is also included which increases the transformer capacity to 76,000kva under emergency conditions. Each transformer will contain about 12,750 gallons of high dielectric strength transformer oil.

Huge Enclosure Shields Guided Missiles . . . The largest pre-fabricated shielded enclosure ever built has been erected at Bell Aircraft Corp., Buffalo, N.Y., for comprehensive electronic testing of guided missiles and small aircraft in their entirety.

The shield measures 40 feet long, 35 feet wide,

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and stands 18 feet high. It was installed primarily to check the electronic installations in the Air Force GAM-63 "Rascal" air-to-surface guided missile and its ground equipment prior to delivery to Holloman Air Force Base, N.Mex., for firing. Engineered and built by Ace Engineering and Machine Co., Philadelphia, Pa., it is made of pre-fabricated, interchangeable panels of galvanized sheet steel which permit the entire structure to be taken down, moved, and reassembled at another location if necessary, with a minimum of time and effort.

An unusual feature of the enclosure is its two electrically controlled sliding doors which can operate independently or together to give a maximum opening 16 feet high by 21 feet wide.

Commutator Alloy Has High Electrical Conductivity
 . . . A copper-zirconium alloy has been developed possessing high electrical conductivity and good strength retention at elevated temperatures.

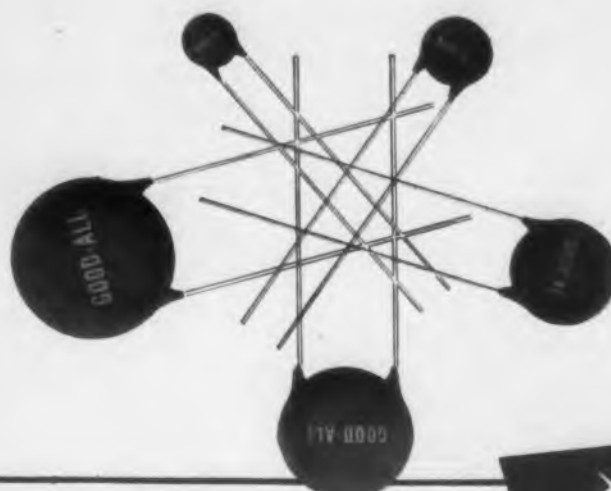
Developed at Battelle Institute, Columbus, Ohio, it is suitable for electric motor commutators serving at temperatures above 500°F and under conditions where strength is required. This alloy is the result of research for the Nippert Electric Products Co., Columbus, Ohio.

Electrical conductivity of the alloy is 95.8% of that of the copper standard. Rate of loss of strength under load is exceptionally low by commutator alloy standards.

Other properties of the alloy include good machinability, ability to develop and maintain a commutator film, and strength increase with notching.

TV Inspects Lithography Blades

The "TV-Eye" closed-circuit TV installation has improved product quality and production at the Cincinnati Machine Shop of the American Can Co. by 100%. It provides remote microscopic inspection of thin scraper blades used in the lithography coating presses. The camera peers at the blades through a microscope and projects the images, magnified 288 times, on a 21" TV receiver a few feet away.



EPOXY COATED CERAMIC DISCS

... at No Premium Cost!

Good-ALL
 capacitors

High Voltage Breakdown Strength

Excellent Moisture Resistance • Durable • Attractive

Good-All's tough, durable EPOXY coated ceramic disc capacitors combine excellent dielectric strength and stability with high humidity resistance. Good-All's exclusive EPOXY coating process results in an intimate bond between the coating and the edge surface of the ceramic. This bond serves to block the voltage breakdown path across the ceramic edge. No wax coating is required on EPOXY coated discs.

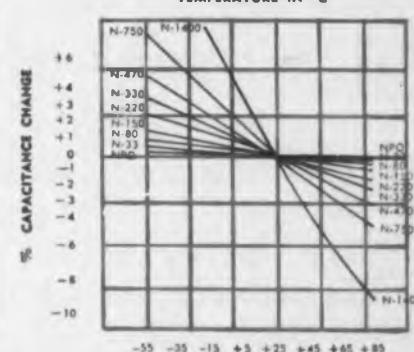
TEMPERATURE COMPENSATING EPOXY DISC CAPACITORS

Good-All has designed a full line of TC discs in accordance with RETMA specification REC-107-A (class 1). These units are well suited for resonant circuits or other applications where HIGH Q and STABILITY of capacitance is essential. Small size gives an inherent advantage in VHF and UHF applications.

SPECIFICATIONS—Working Voltage: 600 VDC • Flash Test Voltage: 1500 VDC • Power Factor: Less than .1% @ 1 MC • Leakage Resistance: Greater than 10,000 meg-ohms • Leads: #22 gage tinned copper wire • Capacity Tolerance: ± 5%, ± 10%, ± 20%

Temperature Coefficient	MAXIMUM DIAMETER				
	1/4	5/16	1/2	5/8	3/4
P-100	1-3 mm	4-9 mm	10-30 mm		
NPO	2-12	13-22	28-60	61-75 mm	76-110 mm
N-33	2-15	16-27	28-60	61-75	76-110
N-80	2-15	16-27	28-60	61-75	76-110
N-150	2-15	16-30	31-60	61-75	76-110
N-220	3-15	16-30	31-75	76-100	101-140
N-330	3-15	16-30	31-75	76-100	101-140
N-470	3-20	21-40	41-80	80-120	121-170
N-750	5-25	26-50	51-150	151-200	201-290
N-1400	15-50	51-100	101-200	200-250	251-470
N-2200	47-75	76-100	101-200	201-275	276-470

CAPACITANCE CHANGE VS. TEMPERATURE IN °C



Good-All's complete line of EPOXY coated ceramic disc capacitors are designed to fit both standard and specialized applications. Write or wire today for catalog containing more information on our TC discs and other EPOXY coated disc types listed below.

BY-PASS Good-All Type B **STABLE** Good-All Type E and EE (RETMA CLASS 2, Z5Z)
DUAL SHIELDED Good-All Type C **HIGH VOLTAGE** Good-All Type G
AC LINE BY-PASS Good-All Type D **TRANSISTOR CIRCUIT** Good-All Type H

Our Sales Representatives will be happy to supply you with sample EPOXY coated discs for test against your specification.

GOOD-ALL ELECTRIC MFG. CO. OGALLALA, NEBR

A LEADING MANUFACTURER OF TUBULAR CAPACITORS

CIRCLE 10 ON READER-SERVICE CARD FOR MORE INFORMATION



R. O. Youngberg (left), Project Department Engineer; J. F. Vinson (center), Designer Engineer, and J. M. Swartz, Structures Design Group Engineer, discuss installation problems associated with a coordinate converter of a new missile electronic system.

MISSILES...THE IDEAL FIELD FOR DESIGNERS

Missile systems design gives Designers the ideal outlet for creative and inventive expression.

Here the Designer works in a growing area where the greatest advances in design are being achieved, an area receiving ever increasing emphasis.

Under Lockheed Missile Systems Division's design policy, Designers receive the broadest possible technical background. Varied assignments, covering structures, controls, hydraulics, pneumatics, electro-mechanical packaging, fuel systems and related areas,

give Designers a thorough grasp of all phases of missile design. Nor is the Designer restricted to conventional approaches in his assignments; new design ideas are welcomed. Moreover, the Designer is kept constantly abreast of the progress of his project.

Through this policy, Designers acquire the technical background so necessary for successful missile design.

Those able to contribute to a design effort of the utmost importance are invited to write. Address inquiries to the Research and Engineering Staff at Van Nuys.

Lockheed MISSILE SYSTEMS DIVISION • LOCKHEED AIRCRAFT CORPORATION

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Lamme Medal Presented To Dr. C. R. Hanna . . . The Lamme Gold Medal was presented recently to Dr. Clinton R. Hanna, associate director of research, Westinghouse Electric Corp., East Pittsburgh, Pa. Dr. Hanna received the medal for his fundamental calculations and developments in the field of electro-dynamics, and particularly for his achievements in the design of generator voltage regulators, automatic rolling mill controls and tank gun stabilizers.

The medal was established in 1928 based on a bequest by the late Benjamin G. Lamme, chief engineer, Westinghouse Electric & Mfg. Co., to be awarded a member of AIEE "who has shown meritorious achievement in the development of electrical apparatus or machinery."

RCA To Offer Lowest Priced Color TV Set . . . RCA recently announced it is mass producing a color TV set with a 21" screen that will retail for \$495 and be introduced to the public in July. This is the lowest price yet announced for a large screen color set.

The set has a viewable picture of 254 sq. in. with a 21" (over-all diameter) tri-color picture tube, and includes 23 tubes, 2 crystals, and 4 rectifiers.

Transistor Clock Lasts Five Years . . . An electric battery clock with a transistor has been introduced by the German firm of Kieninger & Obergfell, St. Georgen (Black Forest, Germany). A single battery gives the clock a running life of approximately five years.

Auto TV A Step Closer . . . American Television & Radio Corp., St. Paul, Minn., recently demonstrated a series of inverters for portable TV sets that will bring car TV a step closer. The device has a plug which fits a car's cigarette lighter and draws power from the battery.

One model, especially designed for RCA's 8½" portable TV, lists for \$42.50. Two other units, designed for Admiral's 10.375" set, and GE's 9" and 14" portables, list for \$84.95.

Electronics Fiscal Budget For 1957 \$1 Billion . . . Of the Defense Department's \$35.6 billion budget for fiscal 1957, about \$1 billion is slated for electronics and communications equipment. Ass't Defense Secretary W. J. McNeil described the appropriation as about three times the amount provided in fiscal 1956, and reflects for the most part the high cost of expanding and improving our extensive system of radar defenses and related communication system.

Expenditures are expected to total \$745 million during 1957, compared with \$671 million in the 1956 fiscal year. For its missile program, the Defense Dept. is asking for \$1.776 billion, compared with \$938 million in fiscal 1956. Expenditures for missiles are expected to total \$1.276 billion, as against a total of \$876 million in the current fiscal year. About \$1.5 billion is being requested for all types of research and development, \$112 million more than provided in fiscal 1956.

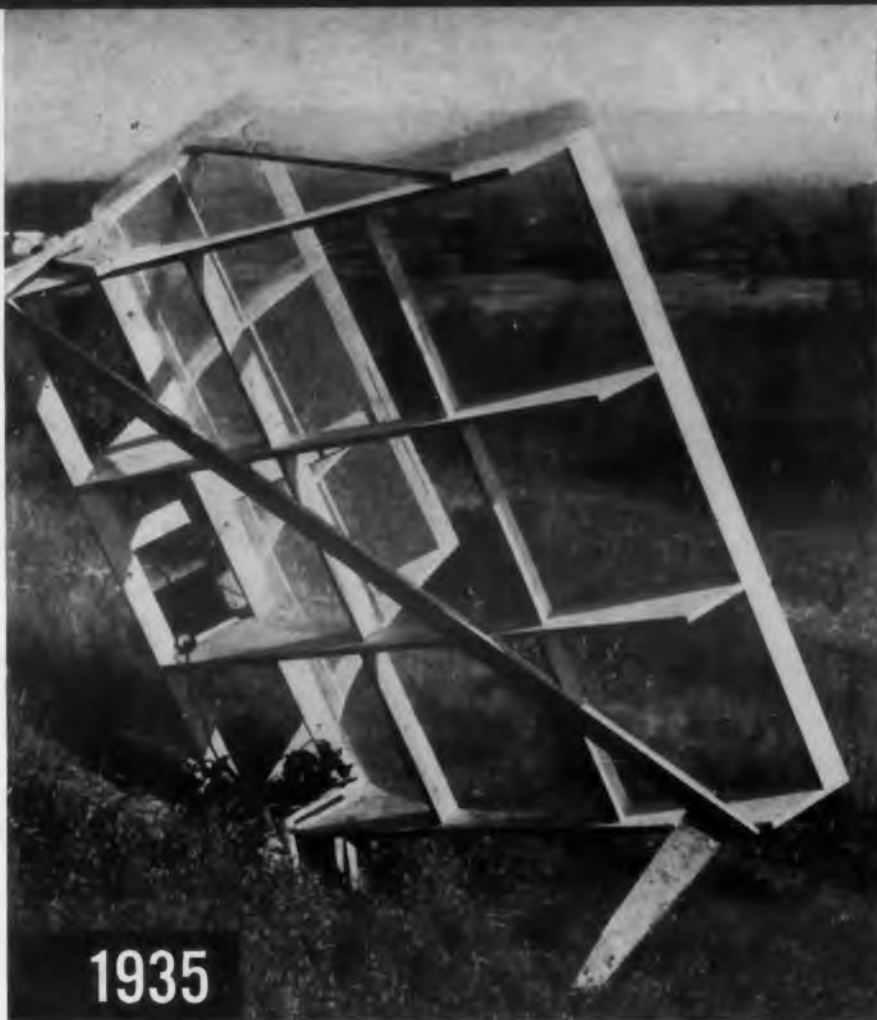
Radar Used For Making Maps . . .

A new and rapid method of preparing maps by using radar has been developed to help provide a quick means for restoring communications in a disaster area.

Developed by the Army's Signal Corps Engineering Laboratories, Fort Monmouth, N.J., the radar-photographic technique requires little time and uses readily available military equipment. In the new system, a radar antenna scans the countryside around the proposed transmission point and a camera photographs the radar screen. Every part of the terrain that reflects on the screen is good reception territory. The photograph is then superimposed on the existing road or contour map, instantly showing the best relay points.

Admiral Producing 1,500 Portable TV Sets A Day . . . Admiral Corp., Chicago, Ill., is ahead of schedule in its production of 10.375" portable TV receivers and is assembling them at the rate of 1,500 a day. The sets will be introduced on a market-by-market basis.

CIRCLE 12 ON READER-SERVICE CARD ➤



1935

EARLY RESEARCH AND DEVELOPMENT EXPERIENCE with electronic location equipment at G.E. began in 1935 when this first system, with an output of 1 1/2 watts, located planes up to five miles away.



1955

IN USE TODAY, this huge nodding height finder was designed and developed by General Electric to be used with powerful search radar systems and is a major contribution to long-range aircraft location.

How G.E.'s 20-year antenna background can help make your radar system more effective

6 examples show experience in all areas of land- and ship-based antenna work

To give you an outstanding source for reliable, precision radar antenna equipment, General Electric backs modern facilities with the know-how that comes from many years of research, engineering, and manufacturing experience.

For example, early research in electronic location equipment at G.E. began in 1935 and engineering and manufacturing experience includes these six major areas:

- 1. Stabilized bases** to compensate for ship pitch and roll were built in large quantity with Navy antennas in World War II.
- 2. Small, portable systems** for weather balloon tracking were developed and produced for the Army and Navy in 1948.
- 3. Powerful heightfinding antenna, FPS-6XW1**, developed by G.E. for USAF in 1949, was an advancement in long-range detection.
- 4. Giant shipboard search antenna**, largest in use today, was G-E developed and produced for Navy early-warning ships.
- 5. Long-range search antennas (FPS-7)** were designed and built by G.E. using advanced construction techniques.

6. One of the first combination antennas (allows both search and elevation detection), the Navy's SPS-8 was designed and produced to give a precise beam pattern.

This extensive background enables clearer perception of special engineering and manufacturing problems. It is the element that helps give G-E precision antenna equipment the efficiency and reliability to help make your radar system more effective. For more information, contact your G-E Apparatus Sales Office or use coupon below.

Mail to: General Electric Company, Section K-223-4
Schenectady 5, N. Y.

Please send me these two bulletins:

GEA-6279, Radar Antennas, Mounts, Components, and Accessories

GED-2494, G.E.'s Naval Ordnance Department Offers Complete Engineering and Manufacturing Services

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GENERAL  ELECTRIC



GLENNITE® PORTABLE ULTRASONIC SOLDERING IRON

AUTOMATIC ultrasonic soldering

...ELIMINATES CORROSIVE FLUX

Gulton Industries' Research-on-the-Production-Line makes possible instant tailoring of basic materials, instruments or complete systems to fill difficult or unusual requirements.

THE PROBLEM: It's one faced by many manufacturers who solder aluminum, magnesium and similar metals requiring corrosive flux. Light bulb producers must now wash their bulb's aluminum base immediately after soldering the leads . . . creating a costly production bottleneck. To further combat pitting action, each high-speed machine has to be constructed of expensive, resistant-type metals. The seriousness of this problem grows with expanding emphasis on lightweight metals.

THE SOLUTION: A GLENNITE Ultrasonic Soldering System which completely does away with flux of any kind! Manufacturing operations are simplified and "speeded up" . . . products never need special treating or cleansing baths. Versatile GLENNITE Soldering Irons are also available in compact, portable units . . . gas or electrically heated . . . for shop and field use.

Vibro-Ceramics' Systems and Tools can radically improve other production techniques . . . ultrasonics provides rapid, yet precise drilling of extra-hard or brittle materials to tolerances within .0005 inch . . . with ultrasound, positive cleaning of assorted products from aircraft pistons to medical syringes is a snap! All versatile, advance-design GLENNITE equipment delivers maximum useable energy with minimum power consumption.

Vibro-Ceramics pioneered commercial development of transducers; this leadership is backed by Gulton Industries' integrated talents, a group of unique facilities available for complete ultrasonic projects . . . from original research to final systems' production. Send for Booklet #306 it contains full information. Inquiries from manufacturers' representatives invited.

VIBRO-CERAMICS

C O R P O R A T I O N

associated with GULTON INDUSTRIES, INC. Metuchen, New Jersey

PIONEERS IN MATERIALS RESEARCH, ELECTRONIC COMPONENTS, PRECISION INSTRUMENTS AND SYSTEMS ENGINEERING



GULTON INDUSTRIES INC

CIRCLE 13 ON READER-SERVICE CARD FOR MORE INFORMATION



FM Carrier Communications System

A new Telecrane FM carrier communications system supplied by Mine Safety Appliances Co., Pittsburgh, Pa., to Sheffield Steel Div., of Armco Steel Corp., Kansas City, Mo., permits direct conversation between control pulpit and crane station in the blooming mill. A microphone in the center is equipped with a footswitch to close a circuit.

Seminar Program For Du Mont Engineers . . . A program of seminars for research engineers has been instituted by Allen B. Du Mont Laboratories, Inc., Clifton, N.J., to keep its engineering specialists well informed of their specialties.

The program is carried on during the work week schedule. It entails weekly lectures by Du Mont engineering and research authorities in the wide variety of electronic fields. They range from "transistor applications in consumer products" to "inertialless data recording" and fields such as "new types of information display devices." The lectures are supplemented with on-the-spot visits to engineering projects throughout the company.

Noise-Cancelling Device

This microphone and headset, developed by Radio Corp. of America for the U.S. Air Force, provides clear communication at high levels of noise. The equipment operates over the full frequency range of 200 to 6100cy, and is capable of a constant level of operations under unpressurized conditions up to 40,000 feet.



ELECTRONIC DESIGN • July 15, 1956

Washington Report

Albert Warren

Washington Trends & Briefs . . . Trade secrets would be jeopardized, Radio-Electronics-TV Mfrs. Assn. and 5 other industry associations told Defense Dept. recently in their protest to new proposed procurement regulation (ASPR IX, Part 2). Defense Dept. had proposed to require contractors to supply govt with technical data and to give govt unlimited use of such data. The 6 groups warned that this provision would remove incentive for research and development because manufacturers would be unable to protect their secrets from competitors. Counter-proposal by associations was that technical data be supplied to govt only if there's clear need for it, if it will definitely foster research and development and if protection of manufacturers' techniques is assured . . . **Air Coordinating Committee** continues meetings in efforts to resolve conflicts between TACAN and VOR/DME civil air navigation facilities. After recent meeting, ACC stated: "It was apparent during the discussion which evolved around costs, time schedule for implementation, international considerations, and operational requirements, that the existing VOR azimuth aid to navigation would be required for the balance of its previously planned useful life" . . . **Greater simplicity and reliability** in military equipment was again urged on industry by Maj. Gen. T. P. Gerrity, asst. to Air Force Deputy Chief of Staff (Material), who stated in speech before Armed Forces Communications & Electronics Assn. that complexity of electronic equipment has "increased the maintenance workload tremendously by virtue of our failure to achieve the necessary reliability." Seriousness of situation is aggravated, he said, by fact that about 42% of Air Force's top electronic technicians would leave service within 2 years, attracted by private industry. On another front, Gen. Gerrity reported that delays in equipment development have been such that only 72% of funds previously scheduled for fiscal 1955 were obligated . . . Air Force has disclosed development, by General Precision Laboratory, of new air navigation system, AN/APN-66, a fully automatic self-contained combination of Doppler radar and automatic dead reckoning. It comprises the AN-APN-81 Doppler radar and AN/APN-95 navigational computer. GPL claims that new system can bring plane within sight of destination after flight covering several thousand miles. Device is free of dependence on ground-based radio aids. Equipment weighs 1200 lb, and GPL reports production at rate of \$1,500,000 monthly.

Potter & Brumfield, inc.

PRESENTS

Series KM RELAY



Write for Samples and Quotations:

For quick delivery over 350 different standard relays stocked by 500 Franchised Distributors throughout the United States and Canada.



Potter & Brumfield
PRINCETON, INDIANA inc.

Subsidiary of AMERICAN MACHINE & FOUNDRY COMPANY

CIRCLE 14 ON READER-SERVICE CARD FOR MORE INFORMATION



In Electronic Fan Design

Only **JOY**
AXIVANE[®]
FANS
Offer All These
Advantages



PRECISION CONSTRUCTION

Precision construction insures performance that gives you great power in so compact a unit.



COMPACT DESIGN

Joy's axivane design permits installation of Axivane fans as part of the duct . . . requires no extra space.



LIGHT WEIGHT

Axivane fans are light in weight as well as compact because they are built from precision aluminum or magnesium castings produced in our own foundry under JOY engineering supervision.



AERODYNAMIC ENGINEERING

The airfoil blades and stationary vanes of JOY fans are made with power-saving, efficient airfoil cross-section. AXIVANE design provides equal pressure and velocity distribution across the fan outlet . . . eliminates turbulence . . . and produces the greatest cooling effect with the least expenditure of power.



MAXIMUM STRENGTH

Joy AXIVANE fans are durable because the outer casing, stationary vanes, and inner casing are precision-cast as a single unit, giving extra strength and maximum resistance to shock.



UNMATCHED EXPERIENCE

Joy's unmatched experience as the world's largest manufacturer of Vaneaxial fans and blowers is a bonus that costs you nothing extra . . . JOY'S leadership is due solely to the multitude of customers who are now enjoying the benefits of outstanding engineering. Why not join the number of satisfied JOY customers . . . you'll be in the best company.



COMPLETE LINE

Joy offers a large selection of fans in the standard line . . . as well as custom-designed types that are available to your specifications. The Joy line includes fans for all purposes ranging from 1/500 HP to 3000 HP. You'll find a fan to suit your needs in the JOY line. Let us work with you. *Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.* In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

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W&D 15837-15

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WORLD'S LARGEST MANUFACTURER
OF VANEAXIAL-TYPE FANS



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CIRCLE 15 ON READER-SERVICE CARD FOR MORE INFORMATION

Meetings

Aug. 20-21: National Telemetry Conference, Biltmore Hotel, Los Angeles, Calif. Sponsored by the IRE, AIEE, Institute of the Aeronautical Sciences, and the Instrument Society of America. Papers will be presented on novel industrial or military applications of telemetry in remote measurement systems, flight test data, remote guidance systems, remote monitoring, and air traffic control. New component developments such as transducers, multiplexers, data recorders, transmitters and receivers, pickoffs, and telemetry filters will be discussed. For information, write to IRE, 1 E. 79th St., New York, N. Y.

Aug. 20-24: Conference on Scientific and Technical Writing, Philadelphia, Pa. Sponsored by the University of Pennsylvania Institute for Cooperative Research. The conference, open to scientists, engineers, editors, writers, and administrators, will provide advanced study and experience-sharing in the art of making technical literature readable. The fundamental problems involved in the communication of technical information will be analyzed, and current systems for handling these problems will be evaluated. For information and applications, write to Dr. Harry F. Arader, 3400 Walnut St., Philadelphia 4, Pa.

Aug. 21-24: Western Electronics Show and Conference, Los Angeles, Calif. Sponsored by the Los Angeles and San Francisco Sections of the IRE and the West Coast Electronics Manufacturers Association. For information, write to Mrs. Jeanne W. Jarrett, WESCON, 344 N. La Brea Ave., Los Angeles 36, Calif.

Sept. 16-22: Second Pacific Area National Meeting and Apparatus Exhibit, Hotel Statler, Los Angeles, Calif. Sponsored by the American Society for Testing Materials. For information, write to American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

Sept. 24-25: Industrial Electronics Conference, Cleveland, Ohio. Sponsored by the Professional Group on Industrial Electronics, IRE. For information, write to G. P. Bosomworth, Firestone Tire & Rubber Co., Engineering Laboratory, Akron 17, Ohio.

Sept. 26-30: New York High Fidelity Show, Trade Show Building, New York, N. Y. Sponsored by the Institute of High Fidelity Manufacturers. The Audio Engineering Society will hold its annual meeting at the show. For information, write to Jack Gilbert Associates, 1186 Broadway, New York 1, N. Y.

Oct. 1-3: Twelfth Annual National Electronics Conference, Hotel Sherman, Chicago, Ill. Sponsored by the AIEE, IRE, Illinois Institute of Technology, University of Illinois, and Northwestern University. More than 100 technical papers and 240 commercial exhibits will be featured. For information, write to Victor J. Danilov, Illinois Institute of Technology, Chicago 16, Ill.

Oct. 1-3: Canadian Institute of Radio Engineers Convention, Automotive Building, Exhibition Park, Toronto, Canada. Technical papers are planned on medical electronics, scatter propagation, application of electronics to atomic energy projects, use of computers in automation and engineering problems, and transistors. An exposition will include many of the latest improvements in radio, radar, TV, control mechanisms, computers, and other electronic items.

For information, write to Grant Smedmor, Convention Manager, 745 Mount Pleasant Road, Toronto 12, Canada.

Oct. 1-5: AIEE Fall General Meeting, Chicago, Ill. For information, write to AIEE, 33 W. 39th St., New York 18, N. Y.

Oct. 3-5: Fifth Annual Meeting of the Standards Engineers Society, Hotel Willard, Washington, D. C. Theme of the meeting is "Standards—Guides for Tomorrow." Sessions are scheduled on standardization in the chemical industry, standards and the atomic energy field, the future trend of standards in the metals field, and creative engineering and standards. For information, contact the Standards Engineers Society, P.O. Box 281, Camden, N. J.

Oct. 8-9: Second Annual Symposium on Aeronautical Communications, Hotel Utica, Utica, N. Y. Sponsored by the IRE Professional Group on Communications Systems. The symposium will stress communication requirements in support of present and future aeronautical activities. The submission of papers on associated topics is invited. Titles, authors, and a brief abstract of 200 words should be submitted to Fred Moskowitz, 1014 N. Madison St., Rome, N. Y., before July 1. For information, write to R. C. Benoit, Jr., 138 Riverview Parkway N., Rome, N. Y.

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Oct. 16-18: Conference on Magnetism and Magnetic Materials, Hotel Statler, Boston, Mass. Sponsored by the AIEE, IRE, American Physical Society, American Institute of Mining and Metallurgical Engineers. Authors should submit titles of proposed papers by June 15 and abstracts by August 1. For further information, write to T. O. Paine, Measurements Laboratory, General Electric Co., W. Lynn, Mass.

Oct. 18-19: Third Annual International Meeting of the Institute of Management Sciences, Statler Hotel, Los Angeles, Calif. Theme of the conference is "Management Sciences—A Progress Report." Program plans include the presentation of technical papers on the latest developments in the application of advanced sciences to business and industrial management. For further information, please contact Al N. Seares, Vice President Remington Rand, Sperry Rand Corp., 315 Fourth Ave., New York 10, N. Y.

Oct. 22-24: AIEE Machine Tool Conference, Sheraton Gibson Hotel, Cincinnati, Ohio. For information, write to AIEE, 33 W. 39th St., New York 18, N. Y.

Oct. 25-26: Second Annual Technical Meeting of the IRE Professional Group on Electron Devices, Shoreham Hotel, Washington, D. C. Titles and abstracts of 100-200 words on papers to be offered for presentation should be submitted to R. L. Pritchard, Research Laboratory, General Electric Co., Schenectady, N. Y., before August 1. For other information, contact Prall Culviner, Sylvania Electric Products, Inc., 1740 Broadway, New York, N. Y.

Oct. 29-30: Third Annual East Coast Conference on Aeronautical and Navigational Electronics, Fifth Regiment Armory, Baltimore, Md. Sponsored by the Baltimore Section and Professional Group on Aeronautical and Navigational Electronics of the IRE. Theme of the conference is "Electronics in the Jet Air Age." For information, write to W. D. Crawford, Publicity Chairman, Westinghouse Electric Corp., Air Arm Div., Friendship International Airport, Baltimore 27, Md.

Nov. 7-9: Conference on Electronic Technology in Medicine and Biology, Governor Clinton Hotel, New York, N. Y. Sponsored by the AIEE, IRE, Instrument Society of America. For information, write to AIEE, 33 W. 39th St., New York, N. Y.

Nov. 26-30: Third International Automation Exposition, Trade Show Building, New York, N. Y. Clinic sessions will be offered in electronic computers, process automation, machine tool automation, office automation, automatic materials handling, servomechanisms, electromechanical components, and electronic components. More than a hundred exhibitors will participate in the clinics. For information, write to Richard Rimbach Associates, 845 Ridge Ave., Pittsburgh 22, Pa.

Oct. 29-Nov. 2: Convention on Ferrites, London, England. Sponsored by the Institution of Electrical Engineers. Program will include sessions on theory, preparation, and properties of ferrites, microwave application, square loop applications, radio and TV applications, and carrier frequency applications. For further information, write to W. K. Brasher, Secretary, Institution of Electrical Engineers, Savoy Place, London W.C. 2, England.

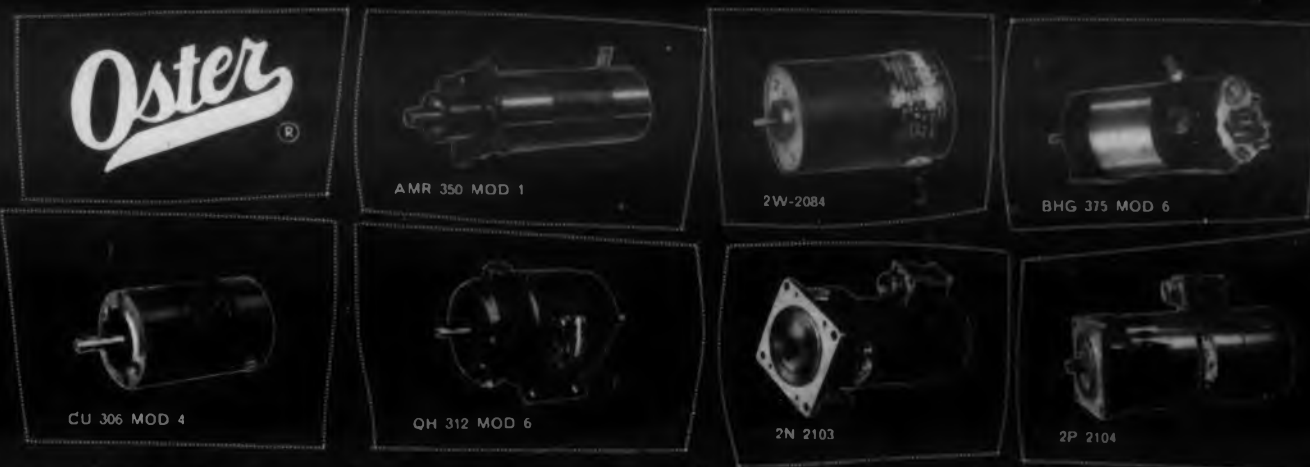
Dec. 5-7: Second IRE Instrumentation Conference, Biltmore Hotel, Atlanta, Ga. Sponsored by the Professional Group on Instrumentation and the Atlanta Section of the IRE. Sessions will be devoted to industrial applications, missile range instrumentation, and the application of solid state devices. Prospective authors are invited to submit abstracts of 200 words or less not later than Sept. 1 to the program chairman, M. D. Prince, Engineering Experiment Station, Georgia Institute of Technology, Atlanta, Ga. For further information, contact the IRE, 1 E. 79th St., New York, N. Y.

Dec. 10-12: Eastern Joint Computer Conference, Hotel New Yorker, New York, N. Y. Sponsored by the IRE, AIEE, Association for Computing Machinery. "New Developments in Computers" is the theme of the meeting. In addition to an extensive program of technical papers, the meeting will feature exhibits by many manufacturers in the computing field. For information, contact Al Forman, Room 639, 480 Lexington Ave., New York 17, N. Y.

Jan. 14-15, 1957: Third National Symposium on Reliability and Quality Control in Electronics, Hotel Statler, Washington, D. C. Sponsored jointly by the IRE Professional Group on Reliability and Quality Control, the American Society for Quality Control, and RETMA. For information, write to IRE, 1 E. 79th St., New York 21, N. Y.

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CU 306 MOD 4	1.937 dia. Size 20	.01 HP	7000 RPM	27 1/2	1	C W	CONT.	Series	
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CIRCLE 18 ON READER-SERVICE CARD FOR MORE INFORMATION

Design Considerations for Semiconductor Regulated Power Supplies

S. Sherr and P. M. Levy
General Precision Laboratory Inc.
Pleasantville, N. Y.

INCREASING use of transistors makes it desirable and feasible to develop compact low voltage power supplies to meet the requirements of this device, and also if possible to eliminate the vacuum tubes completely from the circuit. Vacuum tube low voltage supplies, if they are not to become too bulky and inefficient, are limited generally by the minimum voltage at which the tubes will operate and by the minimum voltage for good voltage reference tubes. The introduction of the reference silicon diode,¹ power rectifiers and power transistors have put the engineer in a position where he can consider the possibility of all semiconductor power supplies. This article describes the combinations which have been discovered to result in the simplest effective circuits.

There are a number of possible combinations which result in regulated power supplies. These combinations include series regulators and shunt regulators. Circuits have been designed to provide either a constant voltage or a constant current. In each case the silicon diode is used as the reference element but it may be replaced by a battery if the current and life requirements are compatible with the available battery.

Series Voltage Regulator (Complementary Transistors)

The circuit of Fig. 1 is usable as a constant voltage source. It will regulate against changes in both input voltage and load as well as act as a ripple filter. This circuit will also work in the complementary configuration, with a p-n-p transistor replacing the n-p-n and vice versa. Using Kirchoff's laws

$$E_0 = \frac{E_i \left[\frac{\beta_2}{r_e (1 - \alpha)} \right] + E_r \left[\frac{\beta_1 \beta_2}{R_b} \right]}{\frac{1}{R_L} + \frac{\beta_1 \beta_2}{R_b}} \quad (1)$$

where $r_e = \delta E_c / \delta I_c$, $I_e = k$. Assume $\beta = \alpha / 1 - \alpha$, β 's $\gg 1$, $r_e (1 - \alpha) \gg R_c$ and $\gg R_b$. In order to find the regulation expression we differentiate with respect to the appropriate variable and divide by E_0 to provide the following results.

$$\frac{dE_0}{E_0} = \left[\frac{1}{1 + \beta_1 \frac{E_r r_e (1 - \alpha)}{E_i R_b}} \right] \frac{dE_i}{E_i} \quad (2)$$

$$\frac{dE_0}{E_0} = \left[\frac{1}{1 + \beta_1 \beta_2 \frac{R_L}{R_b}} \right] \frac{dR_L}{R_L} \quad (3)$$

These two equations express the regulation of this circuit against changes in input voltage and output loads.

Eq. 2 also expresses the percent ripple reduction of this circuit from input to output. The complete analysis of this and other circuits is available in an Appendix which may be requested from ELECTRONIC DESIGN. Regulation of better than 1% and ripple reductions of 100 to 1 have been achieved utilizing this design. A 6v 2amp supply, which was intended as a d-c filament supply was designed using this circuit and gave excellent results. The complete circuit diagram is shown in Fig. 2. As previously stated, it is possible

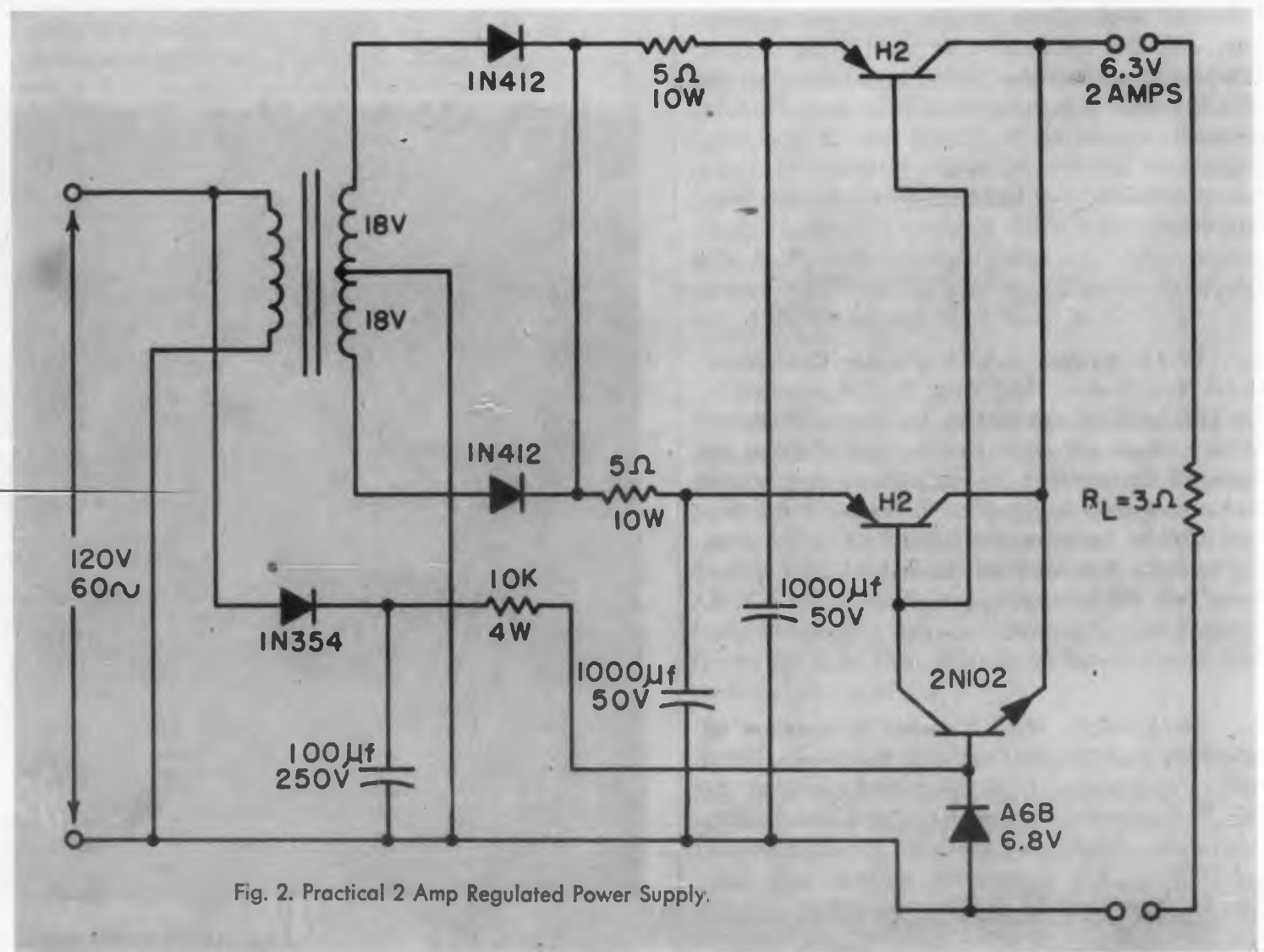


Fig. 2. Practical 2 Amp Regulated Power Supply.

to design this circuit with either the n-p-n or p-n-p as the series element. In the configuration shown, it is preferable to use a germanium transistor as the shunt element in order to keep the drop across it and the series transistor low. A silicon transistor has been used as the shunt element in this circuit but due to its higher saturation resistance, the total dissipation in the regulation circuit was doubled over that required for the all germanium type. The dissipation in the all germanium circuit was 10.5w for an output of 12w

or a total efficiency of 53%. However, in the germanium silicon circuit this dropped to about 35%. The rectifier filter circuit shown was not designed for maximum efficiency, and could be greatly improved by using a choke instead of resistors. Clearly the all germanium circuit is preferable for most applications. This circuit was operated successfully to 60°C with a heat sink.

Series Voltage Regulator (Similar Transistors)

The circuit of Fig. 3 is of interest because it permits the use of only one type of transistor and only adds one resistor to the circuit. This permits all silicon supplies to be built. When p-n-p silicon transistors become available this circuit may not have as much utility. The regulation equation is

$$\frac{dE_0}{E_0} = \left[\frac{1}{1 + \beta_1 \frac{E_r R_c}{E_i R_b}} \right] \frac{dE_i}{E_i} \quad (4)$$

$$\frac{dE_0}{E_0} = \left[\frac{1}{1 + \beta_2 \frac{R_L}{R_c} + \beta_1 \beta_2 \frac{R_L}{R_b}} \right] \frac{dR_L}{R_L} \quad (5)$$

It is generally possible to have R_b reduce to r_b and $\beta_1 E_r / E_i \gg 1$. Under these conditions the regulation term in 4 can take on values as high as 500 using commonly available transistors. However, for high current supplies this circuit will not work as successfully, since for $R_c / R_b \ll 1$, usually R_L / R_b and $R_L / R_c \ll 1$ and the circuit will not regulate too well against load changes. However it does exhibit improvement in regulation against load changes over the complementary circuit of Fig. 1 for medium and low current supplies, though by the same token its regulation against input voltage will be worse by a factor depending on the ratio of $r_c(1-\alpha) / R_c$. A 45v 30ma version of this supply has been built and tested. The regulation against 20% change in E_i and a 50% change in R_L was better than 1%, and the supply operated up to 100°C with a 5% change in output voltage. Most of this change was due to the temperature characteristic of the reference diode and could be corrected down to 1% if a temperature compensated reference diode were used. The efficiency of the supply was better than 75%, and the entire supply, exclusive of transformer and choke was built on a 2" x 2" printed circuit card.

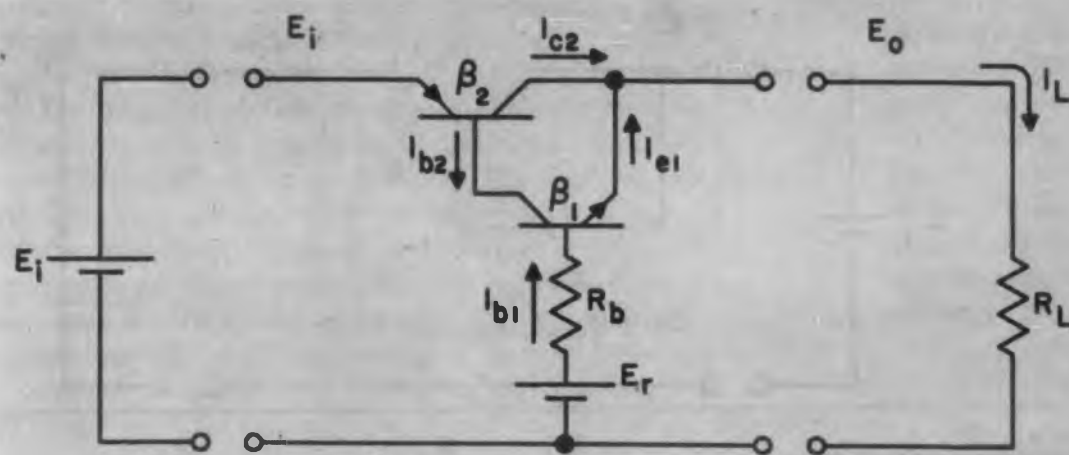


Fig. 1. Series Voltage Regulator Circuit, Complementary Transistors.

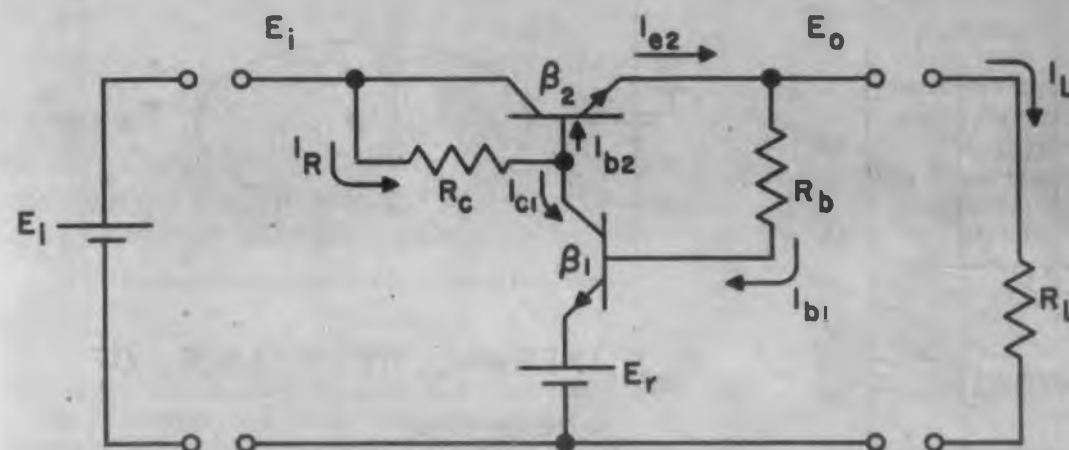


Fig. 3. Circuit With Similar Transistors.

Editor's Note: This article is based on a paper delivered to the Transistor Circuit Conference, Feb. 1956, Philadelphia, Pa. Because of the immense interest expressed in the paper we are reproducing parts here. The original paper covered, in addition, development of equations. At the National Conference of Aeronautical Electronics, May 1956, Dayton, Ohio, the authors delivered a sequel paper which went into, in detail, typical design procedure of the circuits illustrated here. The following three factors were given as describing the operation of the supplies.

Fractional change in output voltage to the fractional change in input voltage

$$K_i = \frac{1}{1 + \beta_1 \frac{E_r r_{c1} (1 - \alpha_1)}{E_i R_b}}$$

Fractional change in output voltage to a fractional change in output level

$$K_L = \frac{1}{1 + \beta_1 \beta_2 \frac{R_L}{R_b}}$$

Ripple Reduction factor

$$K_r = \frac{\beta_2}{\frac{r_{c1} (1 - \alpha_1)}{R_L} + \frac{\beta_1 \beta_2}{R_b}}$$

The completed Dayton paper is published in the Proceedings of the National Conference on Aeronautical Electronics, \$4. Order from National Conference on Aeronautical Electronics, 621 Far Hills Branch, Dayton 9, Ohio.

Shunt Voltage Regulator

A third circuit which is useful in that it requires only one transistor is the shunt regulator shown in Fig. 4. The circuit equation is

$$E_0 = \frac{E_i + \beta E_r R_s / R_b}{1 + R_s / R_L + \beta R_s / R_b} \quad (6)$$

and the regulation equations are

$$\frac{dE_0}{E_0} = \left[\frac{1}{1 + \beta \frac{E_r R_s}{E_i R_b}} \right] \frac{dE_i}{E_i} \quad (7)$$

$$\frac{dE_0}{E_0} = \left[\frac{1}{1 + \frac{R_s}{R_L} + \beta \frac{R_s}{R_b}} \right] \frac{dR_L}{R_L} \quad (8)$$

This circuit will give effective regulation against both input voltage and output load variation. Its major drawback is that it requires considerable dissipation in the series resistor and may often be uneconomical of power, though it does save one transistor. However it is readily possible to calculate the efficiency of this circuit as opposed to one of the others for some fixed regulation factor, and then determine which is engineering wise more feasible. An important advantage of the shunt regulator is that the transistor

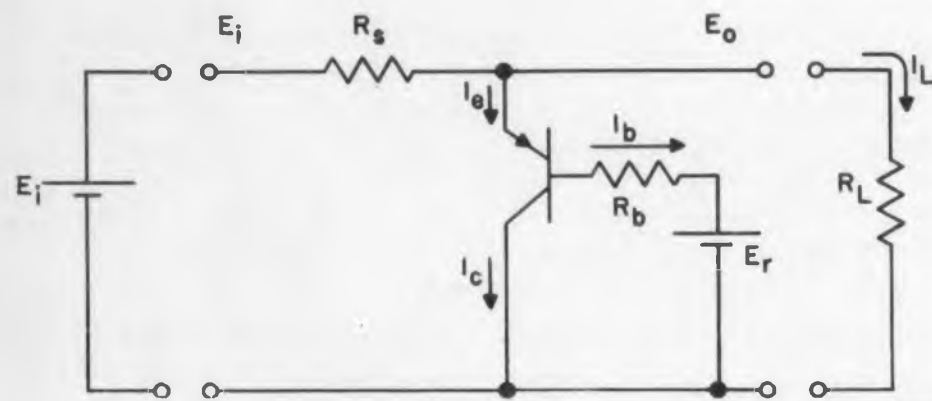


Fig. 4. Shunt Voltage Regulator Circuit.

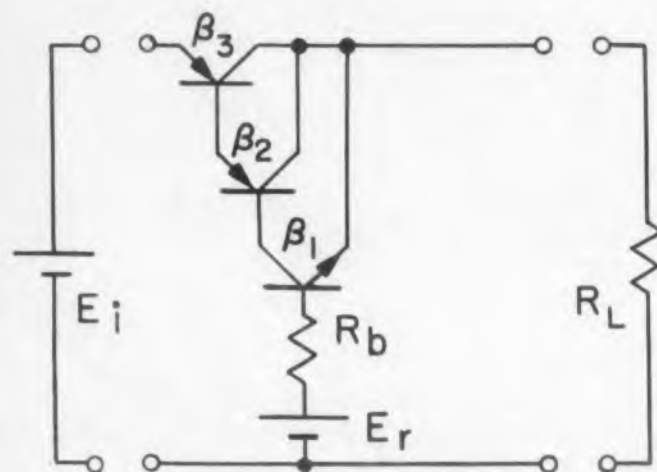


Fig. 6. Series Voltage Regulator (Cascade) Circuit.

does not carry the load current. Therefore a relatively small transistor can control appreciable load current.

Constant Current Supply

A fourth basic circuit which might be mentioned is the current regulator shown in Fig. 5. This circuit utilizes the current amplification of the grounded emitter stage in conjunction with a reference current to produce a constant output current. The circuit equation is

$$I_L = \frac{E_i + \beta E_r \frac{r_c (1 - \alpha)}{R_b}}{r_c (1 - \alpha) + R_L} \quad (9)$$

and the regulation equations are

$$\frac{dI_L}{I_L} = \left[\frac{1}{1 + \beta \frac{E_r r_c (1 - \alpha)}{E_i R_b}} \right] \frac{dE_i}{E_i} \quad (10)$$

$$\frac{dI_L}{I_L} = \left[\frac{-1}{1 + \frac{r_c (1 - \alpha)}{R_L}} \right] \frac{dR_L}{R_L} \quad (11)$$

This circuit is then independent of input voltage and load changes to a very good approximation. Unfortunately the load current will be directly affected by changes in β . However β effects can be stabilized by

d-c feedback methods described elsewhere² and reproducible constant current supplies can be built in this fashion. Cascading transistors will provide higher load currents with a given reference current.

Variations of Basic Supplies

There are certain variations of the above supplies which offer some improvement in performance and should be discussed before the subject is closed. The first of these is shown in Fig. 6. It is easily recognized as a version of the complementary series regulator circuit with the addition of a cascaded transistor stage in the amplifier circuit. The circuit equation is

$$E_0 = \frac{E_i \left[\frac{\beta_2 \beta_3}{r_c (1 - \alpha)} \right] + E_r \left[\frac{\beta_1 \beta_2 \beta_3}{R_b} \right]}{\frac{1}{R_L} + \frac{\beta_1 \beta_2 \beta_3}{R_b}} \quad (12)$$

and the regulation equations are

$$\frac{dE_0}{E_0} = \left[\frac{1}{1 + \beta_1 \frac{E_r r_c (1 - \alpha)}{E_i R_b}} \right] \frac{dE_i}{E_i} \quad (13)$$

$$\frac{dE_0}{E_0} = \left[\frac{1}{1 + \beta_1 \beta_2 \beta_3 \frac{R_L}{R_b}} \right] \frac{dR_L}{R_L} \quad (14)$$

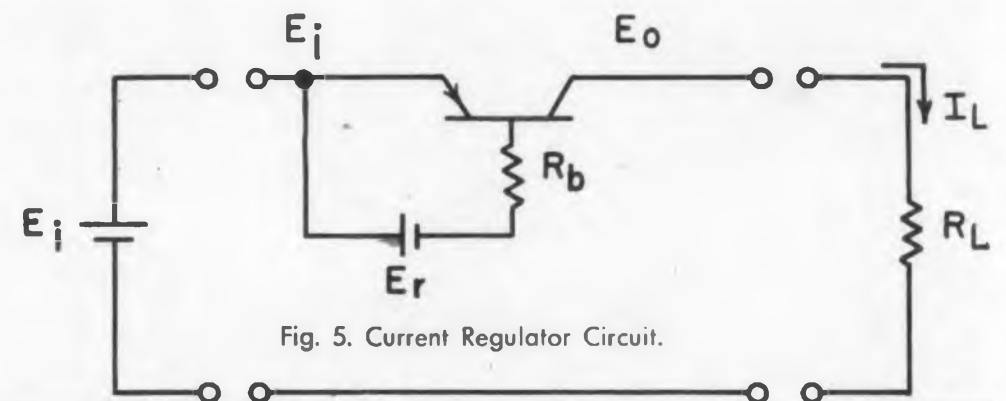
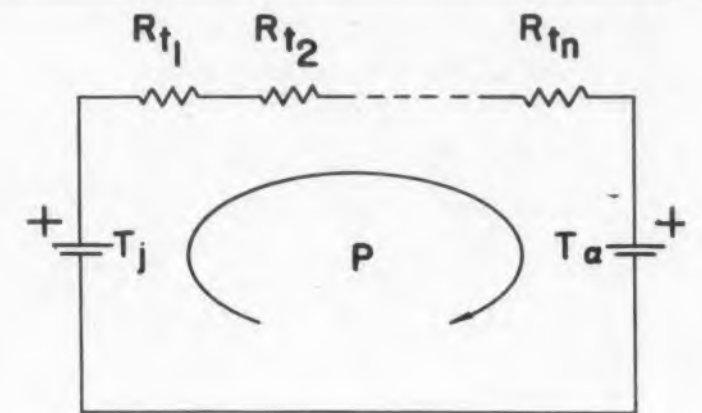
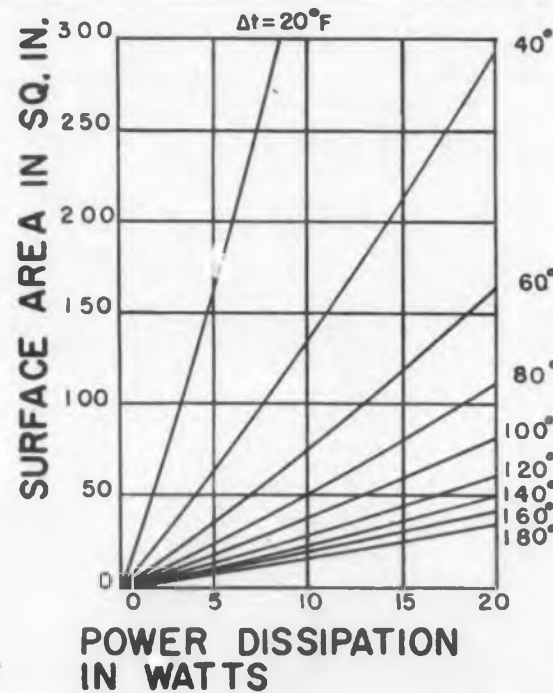


Fig. 5. Current Regulator Circuit.



$R_{tn} \equiv$ THERMAL RESISTANCE OF DISSIPATOR

Fig. 7. Heat Sink Design Considerations.

From these equations we see that the additional transistor improves the regulation against load variations, but has no effect on input voltage variation.

As a final variation, there is the circuit similar to Fig. 4 except that a second transistor is paralleled across the original one. This version of the shunt regulator type supply has as the general circuit equation

$$E_0 = \frac{E_i + \beta_1 \beta_2 \frac{R_s}{R_b} E_r}{1 + \beta_1 \beta_2 \frac{R_s}{R_b} + \frac{R_s}{R_L}} \quad (15)$$

The regulation equations are

$$\frac{dE_0}{E_0} = \left[\frac{1}{1 + \beta_1 \beta_2 \frac{R_s}{E_i R_b}} \right] \frac{dE_i}{E_i} \quad (16)$$

$$\frac{dE_0}{E_0} = \left[\frac{1}{1 + \beta_1 \beta_2 \frac{R_L}{R_b} + \frac{R_L}{R_s}} \right] \frac{dR_L}{R_L} \quad (17)$$

Here the additional transistor improves load regulation and input voltage regulation.

Other variations are possible, using additional cascaded stages.

Heat Sink Design

An additional requirement which is incidental to the circuit design is the necessity for a heat sink for both the rectifier diodes and the series transistor when high currents are desired.

The conduction of heat through a multiple media transmission path is analogous to the conduction of current through a resistive network. The analogy is complete where temperature corresponds to e-m-f, power corresponds to current, and thermal resistance corresponds to ohmic resistance. The equivalent circuit for a transistor operating at a junction temperature T_j and dissipating a power P into an ambient temperature T_a is shown and the corresponding analytical expression is (Fig. 7)

$$T_j = T_a + P \sum_{i=1}^n R_{ti}$$

Knowledge of T_a , T_j , and $\sum_{i=1}^n R_{ti}$ enables one to solve for Δt .

The surface area of the dissipator required is now found from the graph shown³. For forced air cooling, smaller dissipating areas are required.

References

1. Silicon PN Junction Alloy Diodes, G. L. Pearson and B. Sawyer, *IRE Proceedings*, Vol. 40, p. 1348, Nov. 1952.
2. Stabilizing Transistors Against Temperature Variations, S. Sherr and T. Kwap, *Tele-Tech*, p. 74, March 1955.
3. Power Transistor Temperature Rating, L. A. Griffith, *Electronic Design*, p. 22, June 1955.



Hughes has been the leader from the beginning in applying electronic computers to airborne fire control equipment. Today every U.S. Air Force and Canadian continental defense interceptor uses Hughes-developed and Hughes-manufactured systems.

Product Design at HUGHES WEAPON SYSTEMS DEVELOPMENT LABORATORIES

As the intercept problem becomes more and more automatic, additional equipment such as new-type computers, control surface tie-in (CSTI), autopilots, and other units must be integrated into the system. Faster speed and heavier engines dictate more streamlining—and hence less space for electronic gear. The result is even more miniaturization and compact packaging, evolved from special techniques.

This all means that now the product design engineer is more important than ever before. In the Product Design Laboratory he is a vital part of the formal link between the Research and Development activity and the optimum configuration and installation arrangements for the systems "black boxes."

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to work on design and construction of microwave components.

ENGINEERS

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ENGINEERS

to participate in development, design and prototype construction of electrical and electrohydraulic power supplies.

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HYDROGEN THYRATRONS



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For pulse outputs of 2 megawatts—at an average power level of over 1.6 KW.

by *Kuthe*

5957/E-37B

For pulse outputs of 350 KW—at an average power level of more than 400 watts.

Outstanding for compactness, ruggedness, long life and dependability . . . in network discharge service

The new 6587 and 5957/E-37B are advanced developments of *Kuthe* . . . foremost producer in the field.

Both types include an internal hydrogen reservoir across the filament . . . to produce and maintain constant hydrogen pressure . . . to increase the life of these high-quality tubes.

Low time jitter and the power rat-

ing of the 6587 make this type ideal for Moving Target Indicator applications.

The 5957/E-37B, a rugged, miniaturized version of the 4C35 (with 30% of its volume) is especially suited for compact airborne systems.

For complete engineering data, write to *Kuthe*, Dept. W-135.

Principal Electrical-Mechanical Data and Ratings:

	6587	5957/E-37B
Heater voltage	6.3 volts $\pm 7.5\%$	6.3 volts $\pm 7.5\%$
Heater current	11 amperes	6.5 amperes
Reservoir	Conn. across Htr.	Conn. across Htr.
Minimum heating time	3 minutes	3 minutes
Over-all length	7.25" max.	4.375" max.
Greatest diameter	2.56" max.	1.56" max.
Peak anode v. forward	16 kv max.	8.0 kv max.
Peak anode current	325 amps. max.	83 amps. max.
Average anode current	225 ma. max.	100 ma. max.
Operation factor	3.9×10^9	2.5×10^9
Maximum t_{ad}	0.60 μs	0.50 μs
Maximum Δt_{ad}	0.10 μs	0.10 μs
Maximum t_j	0.005 μs	0.01 μs

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Self-Calibrating D-C Voltmeter

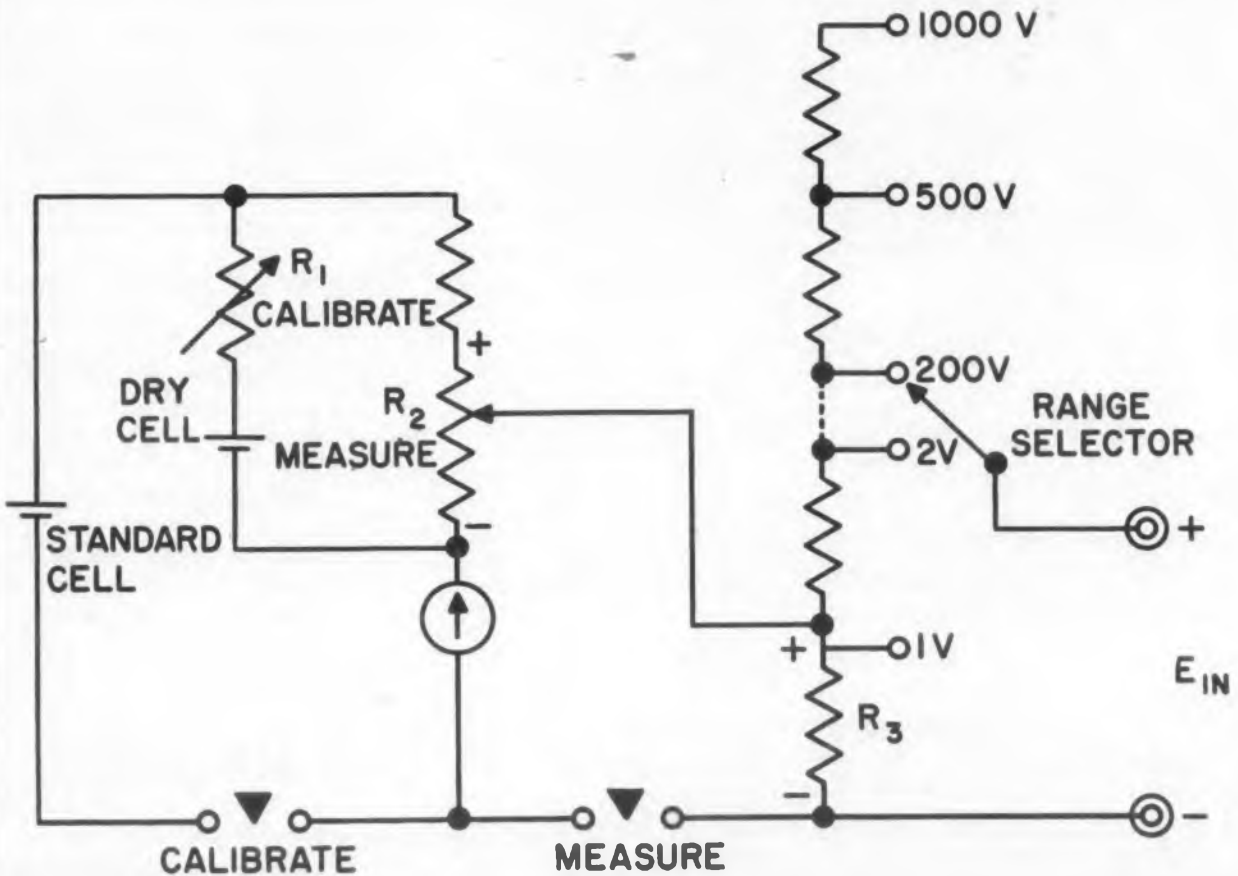


Fig. B. Schematic of the self-calibrating d-c voltmeter.

Fig. A
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Fig. A. D-c voltmeter featuring an internal calibration circuit assuring constant accuracy.

BUILT-IN accuracy is assured with the internal calibration circuit of this d-c voltmeter. Using the potentiometer null-balanced method of measurement, the instrument contains a standard cell as an integral part of the calibration circuit. An ordinary 1-1/2v dry cell in conjunction with a 10-turn potentiometer provides balancing voltage to match the unknown voltage.

To calibrate the meter, the "Calibrate" switch is closed. Then R_1 is adjusted until the voltage of the dry cell is exactly equal to the standard cell voltage. This balanced condition is indicated by a zero reading on the meter. At this point, the voltage drop across the 10-turn potentiometer R_2 is exactly 1v.

Releasing the "Calibrate" switch and pressing the "Measure" switch impresses a calibrated fraction of the input voltage into the meter circuit. Potentiometer R_2 is adjusted until the meter reads zero. Value of the unknown voltage is read directly from the potentiometer dial.

Intended for high-accuracy d-c measurements, the instrument has an accuracy of ± 0.3 per cent of full scale on the 1 volt range and about ± 0.4 per cent on the other ranges. Ten overlapping ranges are provided from 1v to 1000v full scale. Made by Nuclonics Engineering Laboratories, Inc., 32 Monadrook Rd., Wellesley, Mass., the meter is more rugged than precision, moving-coil type devices. It weighs about 5 lbs, making it suitable for field use.

Among the applications recommended for the d-c voltmeter is the calibration of d-c meters. Measuring computer voltages and laboratory testing are other possible uses for the instrument. Absence of vacuum tubes decreases maintenance, increases reliability and eliminates warm-up time. For further data on the d-c voltmeter, turn to Reader's Service Card and circle No. 21.

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Where specifications read "ruggedized", it means instruments that can really *take punishment, and come through!* That's why WESTON is industry's *major* supply source, and the *exclusive* source for ruggedized panel instruments in *all* sizes in A-C, D-C, RF, and THERMO types. For the complete story on WESTON

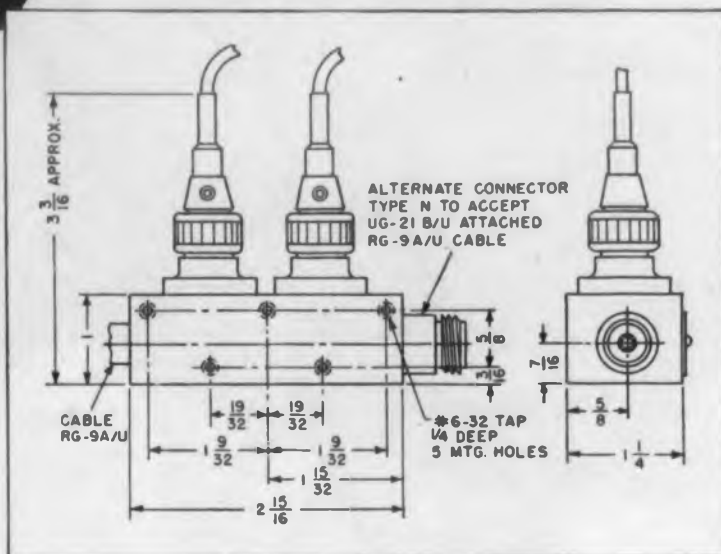
ruggedized meters, as well as on the full line of conventional and core-magnet type panel meters, consult the Weston representative near you, or write WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, N. J. A subsidiary of Daystrom, Incorporated.

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YOU KNOW WHAT'S GOING OUT**



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Fig. C Plug-in type high-sensitivity relay with cover removed.

High Sensitivity

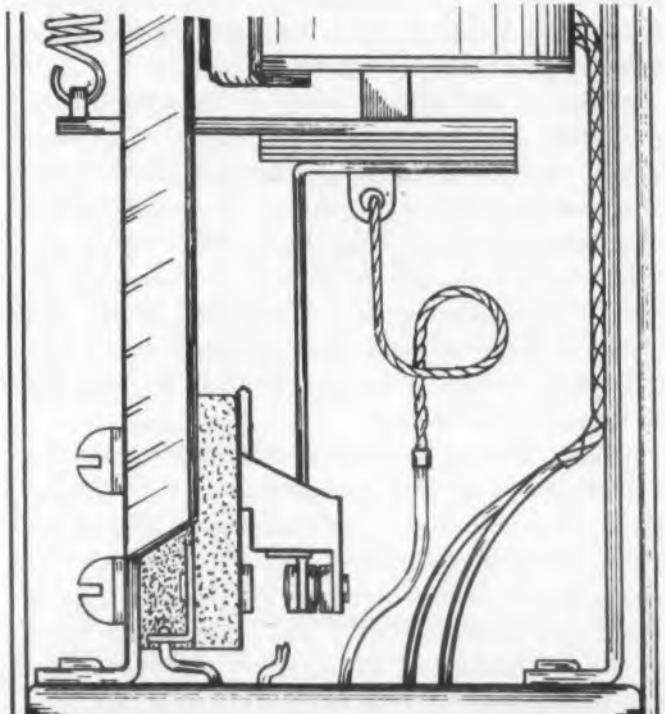
SEVERAL design features built into this relay contribute to its high sensitivity and long operating life. An essentially friction-free armature movement, wiping contacts, and elimination of residual magnetic effects permit a sensitivity as low as 5mw.

Mounted at the end of a slightly flexible arm, the moving contacts touch the stationary contacts slightly before the armature comes to rest. During the last few mils of armature travel, the moving contacts are pulled in a wiping motion about 0.006" across the stationary contacts.

This wiping action serves two purposes: first, to clean impurities from the contacts, and second, to assure a good electrical connection. Long operating life without bounce or chatter are other benefits derived from this operation.

One of the factors contributing to high sensitivity is a "floating" armature design. Instead of the usual hinge pins, a relatively friction-free

Fig. A When energized, left, the armature of the spdt relay moves in a slight arc causing a wiping action of the contacts after they touch. When de-energized, right, the spring pulls armature to "open" position.



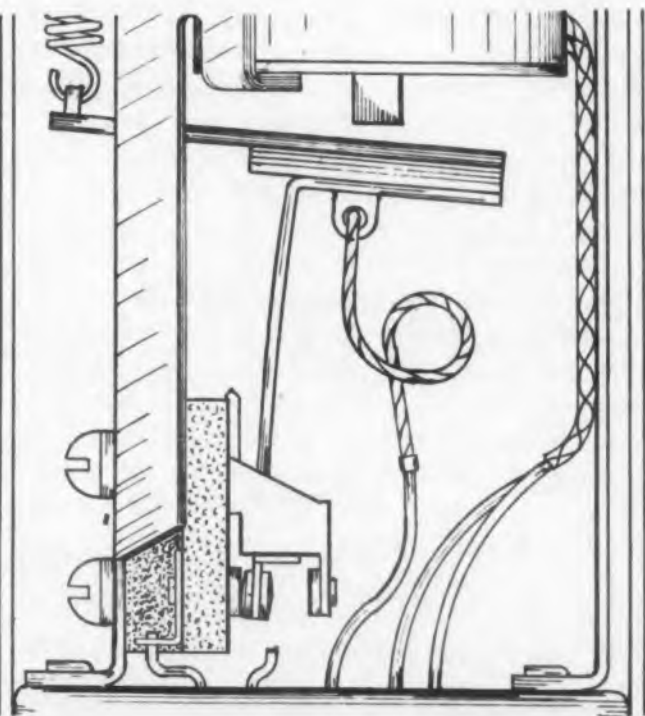
Relay

fulcrum mounting arrangement is thus used.

Residual magnetic effects tending to decrease sensitivity are minimized by using hydrogen annealed magnetic parts of high-permeability, nickel alloy steel.

Optimum magnetic flux is achieved by using a large number of ampere-turns for each coil resistance. An iron core as large as reasonably possible also creates an efficient magnetic field.

According to the manufacturer, Hedin Tele-Technical Corp., 640 W. Mt. Pleasant Ave., Livingston, N. J., the relay is designed for a-c or d-c applications. Contact rating is 1 amp inductive or 5 amp resistive. Contact material may be either silver, palladium, gold alloy, or various alloy variations. Plug-in, solder lug, or fixed mounting types are available. Dust covers may be hermetically sealed. For further information on this high sensitivity long-operating relay, turn to Reader's Service Card and circle No. 24.



About a Sawtooth, Clamping and your Efficiency...

Let's look at it this way—What features should an instrument incorporate to make your job easier, help prevent costly mistakes? Take the case of the new PRD Klystron Power Supply. Should we incorporate a sawtooth rather than a sine wave modulation? It's easier to put in a sine wave. However, a sawtooth has the definite advantage of eliminating phasing and blanking problems when the frequency response of a transmission device is to be studied. So, in goes the sawtooth. It's easy enough to get hold of some sine wave modulation which can be applied through the external modulation input.

As for preventing mistakes—consider switching from cw to square wave modulation. Suppose you forget to readjust the reflector voltage . . . Sure, you'll catch the mistake later, but time is lost. The new PRD Klystron Power Supply has an electronic clamping circuit which locks the top of the square wave to the previously chosen reflector voltage. No readjustments to think about, no mistakes.

Want to modulate with pulses—use the external input. The rise time degradation of your pulses will be less than .1 microsecond!

Another point, good regulation! Here's an example: a $\pm 10\%$ line change or any load change will cause a reflector voltage change of only $\pm 0.1\%$.

Compare . . . chances are that you'll send in your order for the PRD Type 809, too.

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CAN DO FOR YOU

- Powers most low and medium voltage klystrons—up to 600 V beam supply
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What's Inside Transac—II

A. L. Cavalieri, Jr.

Philco Corp., Government and Industrial Div.

HIGH speed, reliable computer operation has been achieved using transistors in direct coupled circuits. In Part I of this article describing the Transac, basic circuits and arithmetic units for basic operations were discussed. This part discusses control, memory circuits, and communications with the computer. These circuits are representative of many possible configurations and are, at present, necessarily limited by the state of the transistor art.

Control of the Computer

The arithmetic section can perform simple arithmetic operations. But it must be told what to do and when to act. This requires communication both with the permanent memory for the instructions, and with the data memory and the input. Communication from memory is in the form of an array of digits. When decoded the digits might mean "multiply the number in the data section indicated by this following ad-

dress by the number in the multiplier-quotient register."

To signify multiply, or to indicate the position of the multiplier, a pyramid of AND gates actuated by a group of flip flops might be used. The pyramid is such that there is one unique path through it to some output line for each series of digits. In the example, Fig. 1, four inputs are required. If these inputs energize transistors 1_0 , 2_1 , 3_1 , and 4_1 , a conducting path at the

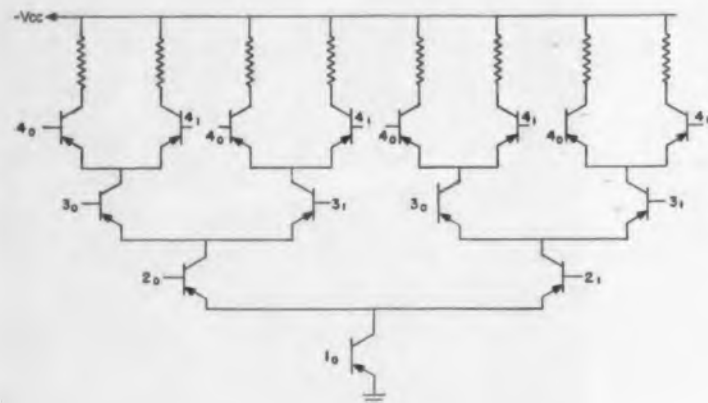


Fig. 1. A pyramid of AND gates. Large units designate the flip flop to which the base in question is connected. Subscript defines the state of that flip flop which will cause the base to conduct.

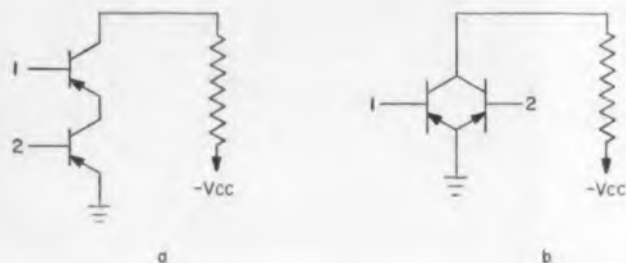


Fig. 2. Dual AND-OR gates. Circuit a is the inverse of b.

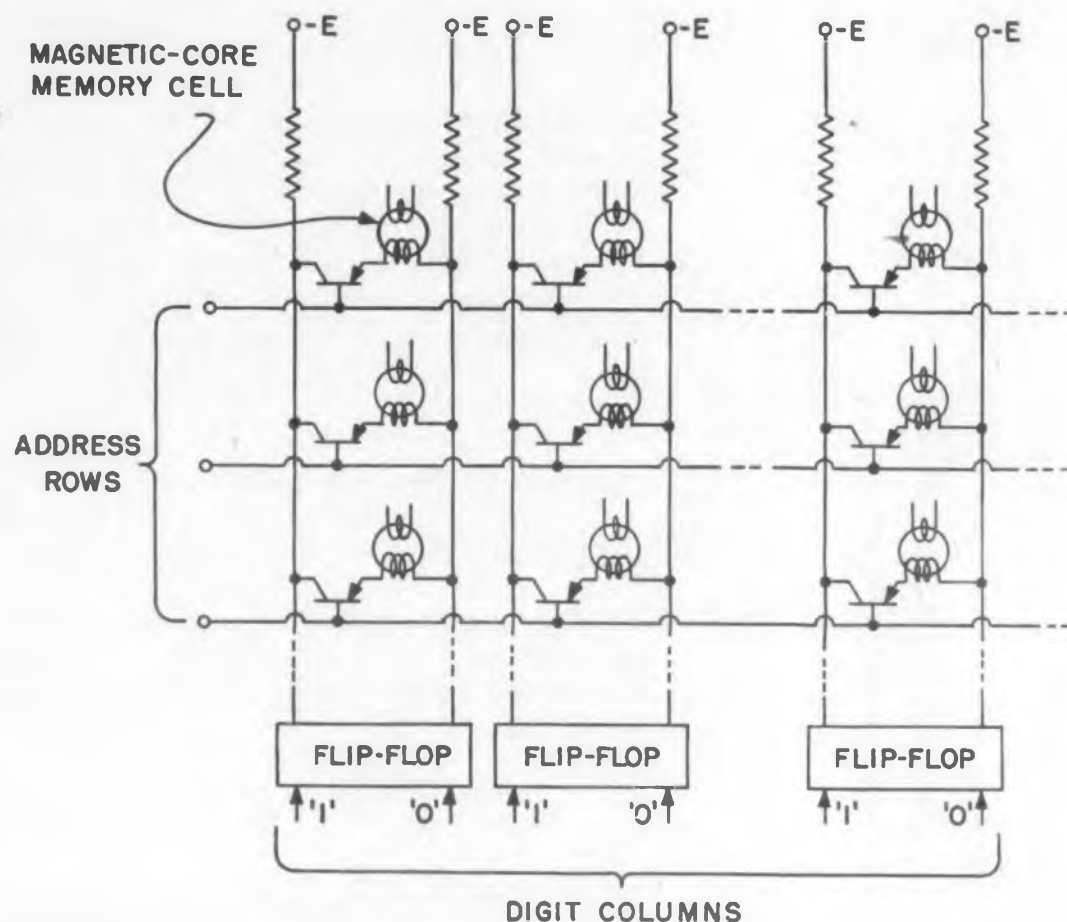


Fig. 3. Typical data memory circuit.

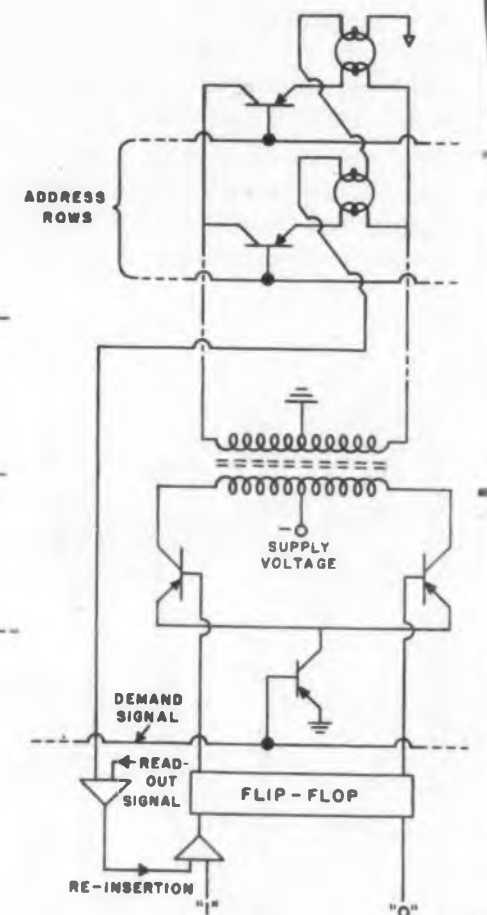


Fig. 4. Memory driver circuit. Original stored information is retained.

extreme right side of the diagram is formed, and that output terminal rises to a potential close to the ground.

These transistors are energized by four flip flops which have been set in some pattern, possibly by the instruction from the memory.

Depending upon the nature of the stage to be driven, a potential near ground may or may not be suitable. However, it is possible to follow each output with an inverter or make use of parallel rather than series AND gates, Fig. 2. In the circuit of Fig. 2a, a negative OR pulse can be created by dropping the potential of either input 1 or 2 provided that both 1 and 2 were originally in a conducting state, both 1 and 2 would have to be energized to produce a positive AND pulse. The circuit of Fig. 2b is just the inverse of Fig. 2a in that it produces negative AND pulses and positive OR pulses. Height of an AND pyramid of this type is limited by the finite drive capabilities of transistors in current production. To handle more precise or detailed instruction, it is necessary to insert buffer stages between flip flops and the pyramid so that no more than four transistors are driven from one.

Memory Circuit

The program or schedule of operation for Transac may be stored on a drum from which it is read off in a parallel fashion. Certain fixed information may also be wired into a transistor memory section, with provision for replacing this section with another when it becomes necessary to the stored data.

Transac circuits are also applied to the data storage or "scratch pad" memory. In fact, circuits can be designed to retain the information in this memory as long as the computer remains energized. A simple circuit for data storage with parallel input and output is shown in Fig. 3.

To read-in, the digit flip flops are set to the desired condition and the address wires are energized. The cores will be set to a position corresponding to that of the flip flops. Because the transistors are really two-way gates, they will conduct almost equally well in either direction provided an appropriate change in the polarity of collector to emitter voltage is made.

To read out, all flip flops are set to a zero condition, then the address lines are energized. In the sensing windings associated with those cores where a change in magnetic state occurs, a voltage pulse is instantaneously generated. The parallel presentation of stored information is achieved but only at the expenses of losing the original stored information.

It is possible to return the cores to their original state through circuitry such as in Fig. 4. In that circuit, the flip flops and address lines must be in their proper condition before the demand line is energized. The polarity of the voltage pulse in the transformer secondary will be determined by the side of the primary windings that carries current.

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Microwave relay system designers and equipment buyers have long known that Varian relay klystrons are unmatched for frequency stability, power to override noise, reliability and long life. The VA-220 gives you performance that even exceeds the high standards set by Varian X-26 klystrons... at half the cost.

In the 6000 - 8000 megacycle band, VA-220 klystrons will consistently outperform all others. Here are six reasons why this sensational new klystron is your best buy for all relay applications:

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TYPE	FREQUENCY RANGE	RESONATOR VOLTAGE	POWER OUTPUT	BANDWIDTH	MODULATION SENSITIVITY
VA-220*	5925 - 7425 mc	750 v	1.2 watts	35 mc	375 kc/v
*VA-220 B, C, D, E and F each cover a frequency range of approximately 300 mc					

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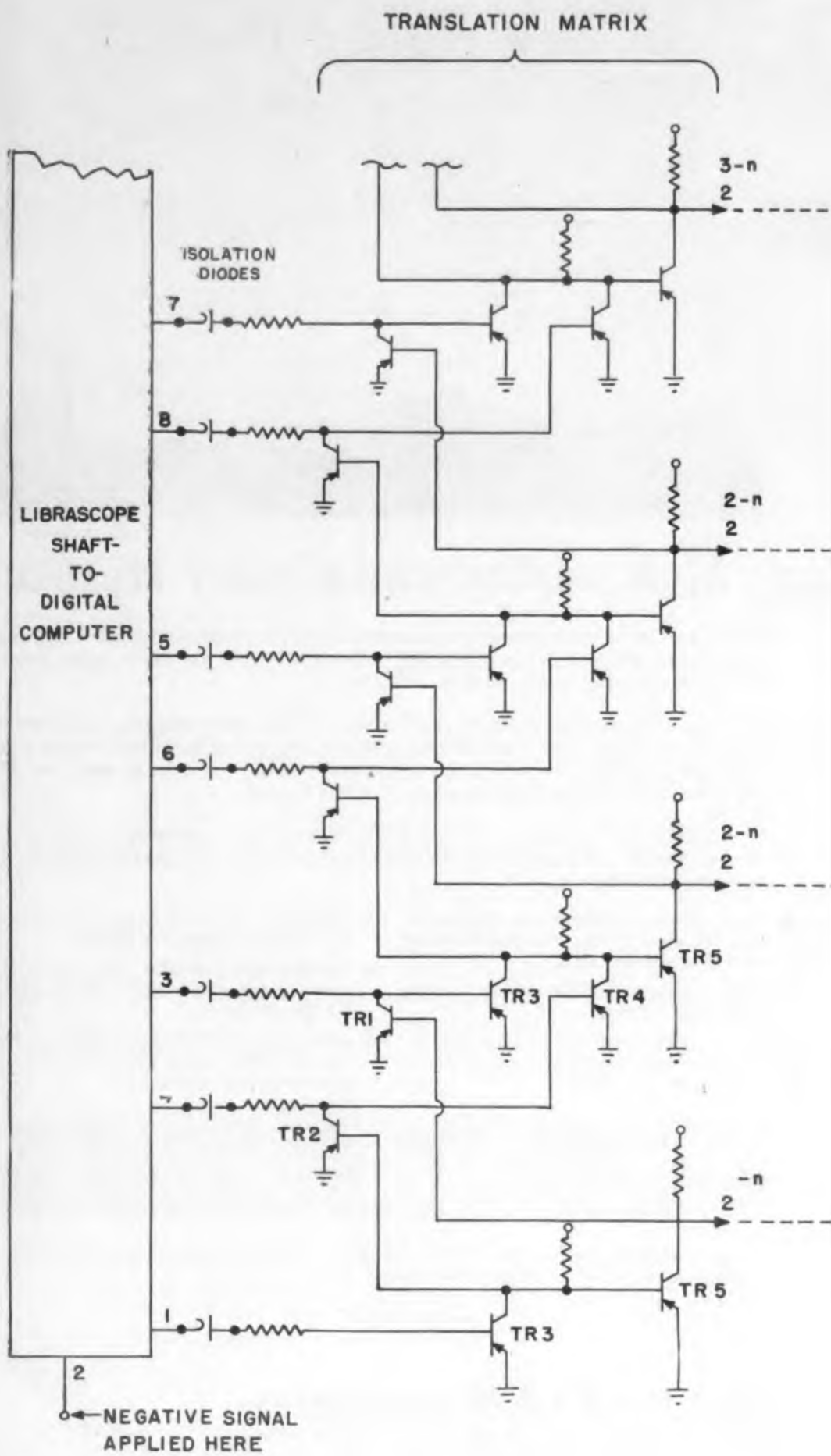


Fig. 5. Translation matrix used with a coded disc input.

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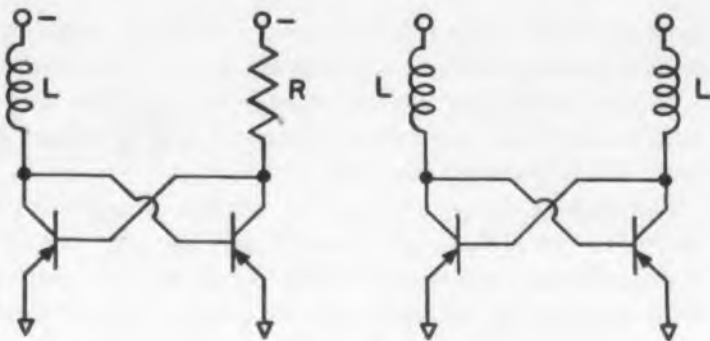
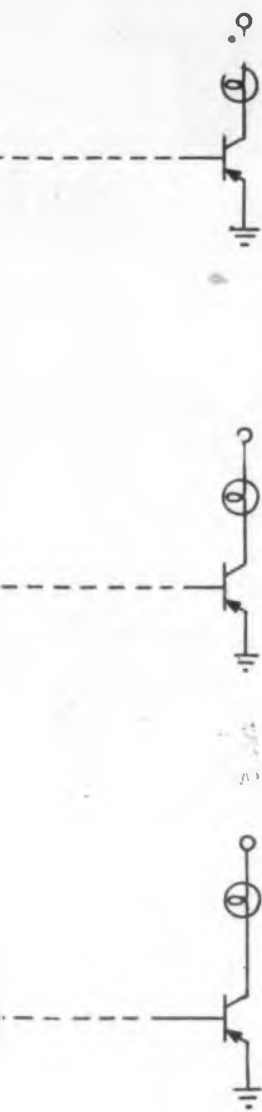


Fig. 6. Monostable circuit, a, may be converted into a free-running multivibrator, b, by replacing the resistor R with an inductance.

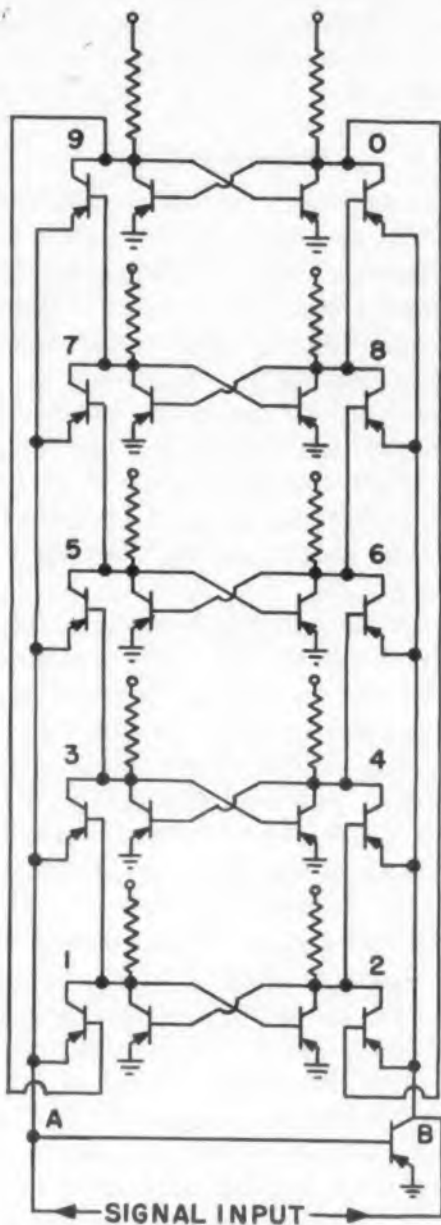


Fig. 7. One variety of a transistorized decade ring counter.

If an output pulse is generated with a read-out signal present, it will be gated back to the flip flop, setting the flip flop state corresponding to the original state of the core. The core will then be returned to its original state.

Communicating with the Computer

Electro-mechanical inputs of the Teletype, Flexewriter, or Kleinschmidt variety provide suitable digitized inputs. Similar output devices may also be used but it might be necessary to feed the computer output into some storage medium for processing on some other occasion.

Particularly well suited to the Transac computer is the Gray code disc. Because of the brush arrangement in this device, a translation matrix, Fig. 5, is necessary to provide non-ambiguous outputs from the $2n-1$ terminals available to the converter. Any signal at output 4 can reach transistor 4 causing it to conduct and cut off 5. A negative pulse at the collector of transistor 5 is, then, the output. Transistor 1 is energized and no matter what happens at terminal 3, transistor 3 is held off and at that signal cannot propagate.

Setting time of this matrix is about $4\mu\text{sec}$ while gating out requires about $0.25\mu\text{sec}$. Thus, a given shaft position can be read into the computer in about $4.25\mu\text{sec}$.

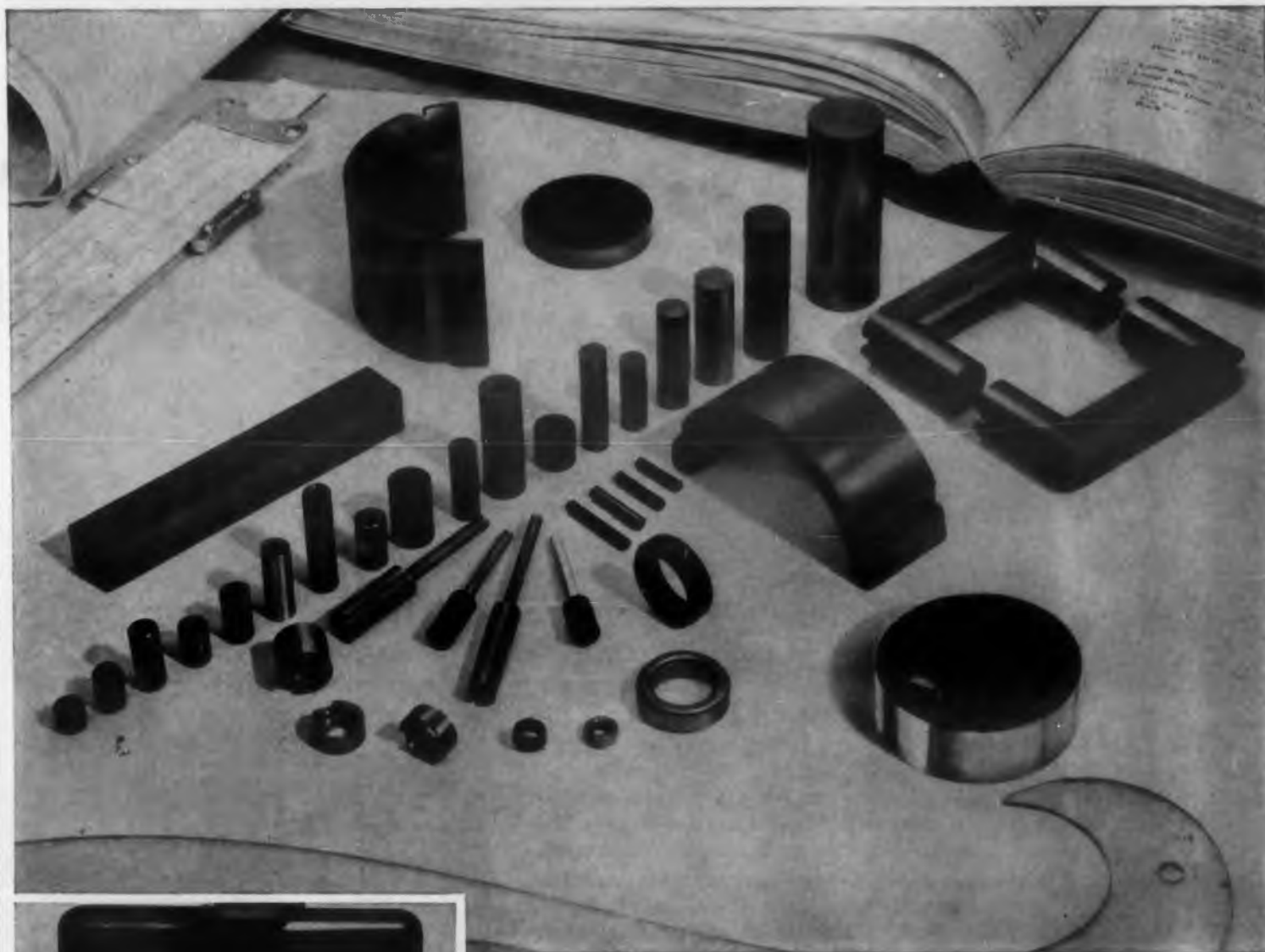
Other Direct-Coupled Circuits

The family of Transac circuits includes many members which, although they have not found extensive use in computers, are nevertheless interesting and potentially useful. The simplest of these is the monostable circuit of Fig. 6a. The circuit is stable with the transistor 2 conducting. Flipping the device to its alternate state requires temporarily grounding the base of that transistor. This alternate state is maintained until the voltage at that base of transistor 2 rises to a value allowing conduction. Replacing the resistor in the monostable circuit with an inductor, Fig. 6b, the multivibrator will free-run at a frequency depending upon the values of the inductances.

Transac circuits need not be limited to simple two-state devices. A wide variety of coded and uncoded counters have been developed. The transistorized decade ring counter, Fig. 7, requires two inputs such as obtained from a scale of two counter. A positive input at either terminal energizes the associated line. Those transistors with their emitters tied to that line conduct if the base voltages are suitable.

Acknowledgements

The author wishes to acknowledge the aid of Ralph H. Beter and Ralph B. Brown of the Philco Corporation.



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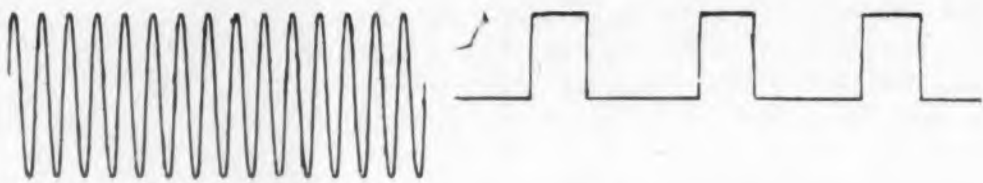
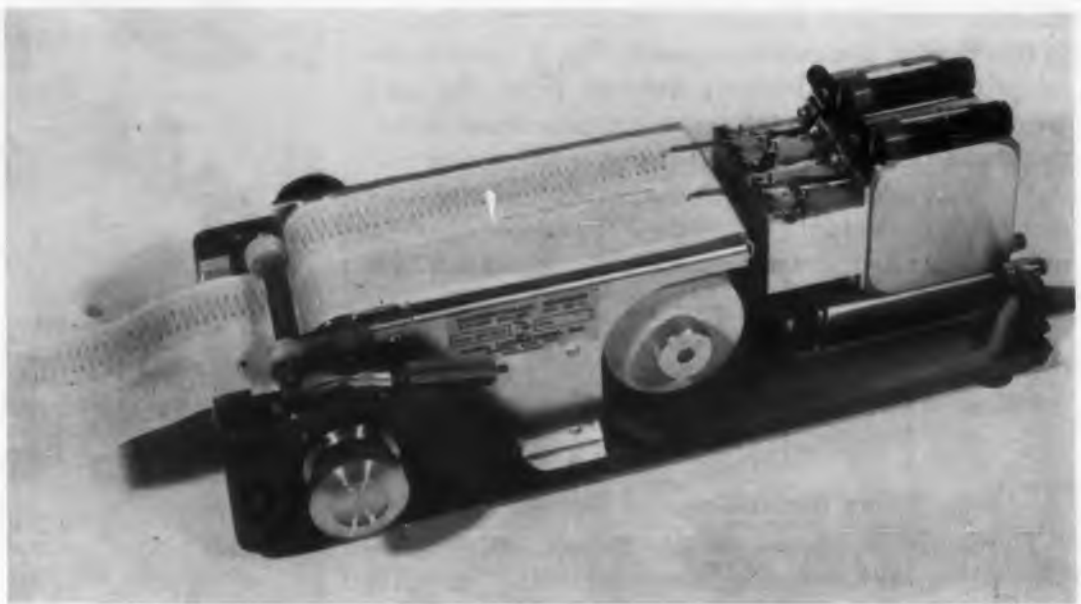
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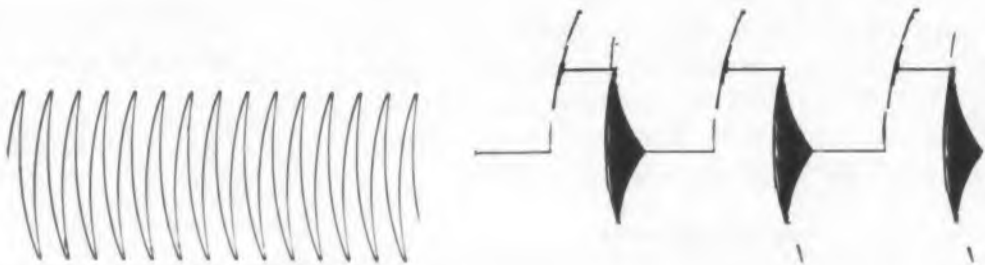
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to l

ACOUSTICAL damping of the pen, elimination of curvilinear distortion, and elimination of massive magnets are features of the high-speed direct inking chart recorder illustrated here. The frequency range is from d-c to 200cps. Highest chart speed is 200mm/sec.

Critical acoustic damping in the new recorder made by Massa Laboratories, Inc., 5 Fottler Rd., Hingham, Mass., completely eliminates any resonance peak in the response. This results in excellent transient response, which makes the pen motor independent of the amplifier compensation so that it may be used as a true recording milliammeter. Pen design includes a built-in mechanical filter that permits smooth, splatter-free writing at all frequencies up to 200cps. A cross section of a portion of the pen is shown in the attached sketch. A novel linkage assembly produces true rectilinear motion of the pen tip and eliminates the familiar curvilinear distortion present in the conventional D'Arsonval type instruments.

The Massa Electrodynamic Recorder uses a typical cylindrical driving coil mounted in a coaxial magnetic field, which means that all of the air gap flux is effectively used in the operation of the instrument. Because of the greatly increased air gap efficiency that results from this new design, a rugged, high sensitivity pen motor has been made possible which weighs only 1-1/2 lbs. Sensitivity is 20ma rms full scale deflection. The decrease in size resulting from the new design has made it possible to include a fixed mounting base as an integral part of the pen motor assembly, which permits multiple channels to be spaced only 1-1/4" on centers. The complete two channel system weighs 10 lbs.

The recorder includes a paper chart drive with decimal speed changes of 0.01sec, 0.1sec and 1sec which permits the direct reading of time scales on the chart at any selected speed. The time resolution is approximately 1 millisecond. The chart strips reproduced here compare actual recordings of a 60cps sine wave and a repetitive step function as made on the new recorder and on a D'Arsonval type instrument. The complete absence of curvilinear distortion as well as the complete absence of ringing and overshoot is noted in the Massa recordings as compared to the distorted records made on the D'Arsonval type instrument. For more information on the item, turn to the Reader's Service Card and circle No. 29.



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Fig. C. An example of one possible form of a typical printed-circuit dial plate.

Meter-Type Analog-to-Digital Converter

ALMOST any quantity that can be measured with an ordinary D'Arsonval meter movement may be converted into digital units with this relatively simple device. Basically, the device uses the meter pointer to complete an electrical circuit between contacts on the scale of the meter assembly. Digital output depends upon the position of the pointer and may be read out at predetermined intervals. Because the converter is inherently low-current consuming, it was named LIAD (Low I, Analog-to-Digital).

Heart of the device is a D'Arsonval meter movement. Sensitivity can be that of most available meter movements. Thus, LIAD may be

driven directly from thermocouples, ion gages, differential transformers, strain gages, bridges, photocells, and various other types of transducers. Vacuum tubes are not essential to the operation of the converter.

In place of the standard meter scale, designers at Assembly Products, Inc., Chesterland, Ohio, have incorporated a printed-circuit board over which the indicating pointer moves. This printed-circuit dial plate may be divided into several bands; each band is divided into segments. For each value being measured by the meter signal coil, the pointer is positioned over a particular combination of contacts. Arrangement of these

bands and segments determines code output.

In operation, the indicating pointer moves freely over the printed-circuit scale. A readout coil, energized either automatically or manually, pulls a "clammer" or pusher bar against the pointer and pushes it against the printed scale. Individual segments or bands are energized only if a contact is under the pointer at the time the readout coil is energized. Feeding these outputs to proper indicators produces a binary code indicative of pointer position. At present a maximum of six bands on the printed scale is feasible; up to 64 positions can be indicated. Possible resolution is about 1-1/2 percent.



Fig. A. Meter-type analog-to-digital converter with cover removed.

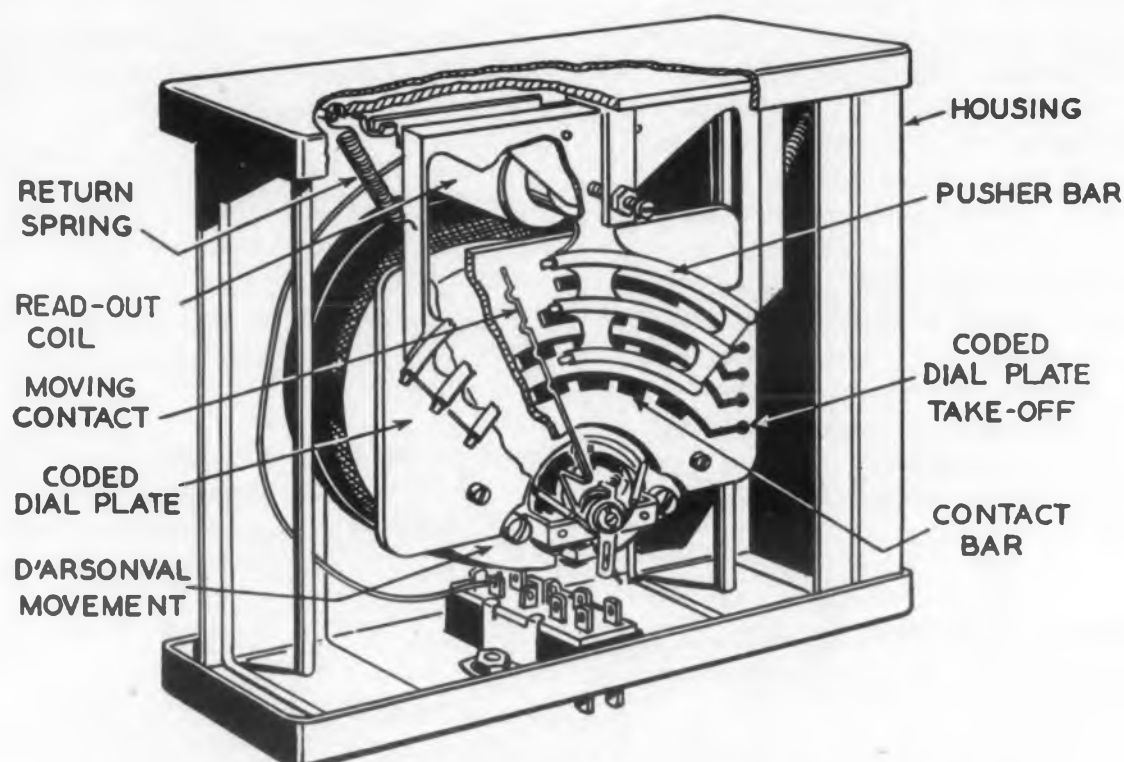


Fig. B. Cutaway view of LIAD showing how the indicator pointer is placed between the pusher bar and the coded printed-circuit dial plate.

Standard coil sensitivities are 1ma at 100 ohms or 100 μ a at 3000 ohms. Response time ranges from 1/4 to 3/4 seconds. Contacts are rated at 100ma at 100v d-c or 0.5 amp at 110v a-c. A clockwork mechanism is available to energize the readout coil at rates ranging from two per second to one per hour.

Some of the suggested applications include telemetering, automatic production testing or grading, maximum value reading, or simple quantitative readout. Values of pressure, flow, liquid level, temperature, voltage, or current may be converted into a series of pulses and transmitted without inaccuracies due to line losses. Resistors, vacuum tubes and similar components may be tested to determine quality level. Coded output of the LIAD may be used to actuate suitable relays or gates.

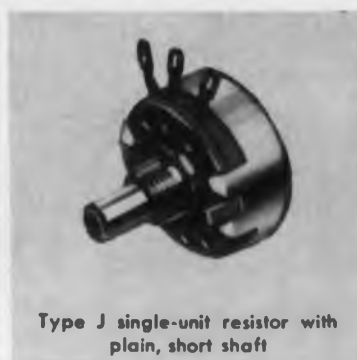
A system using four 10-segment LIAD's has been developed to provide readout of information stored in decade counters. Readings up to 9999 are provided. Readout is accomplished by actuating proper circuits to electrodes of Inditron tubes to give direct readings of rpm, pressure, etc. Nixie tubes or digital in-line readout devices may also be used. LIAD may also work directly into printers. For further information, turn to Reader's Service Card and circle No. 31.



Type J dual control with line switch



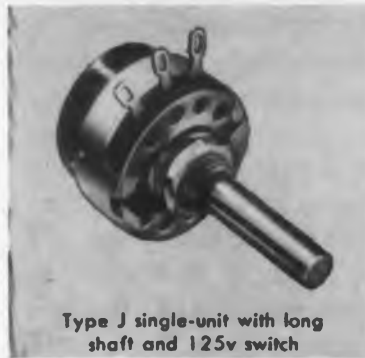
Type J resistor with short shaft and lock-type bushing



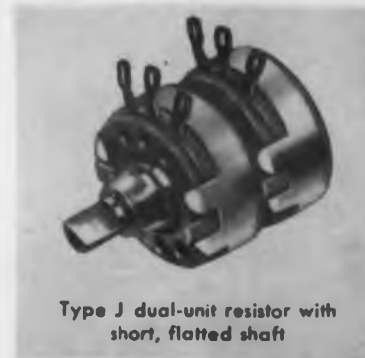
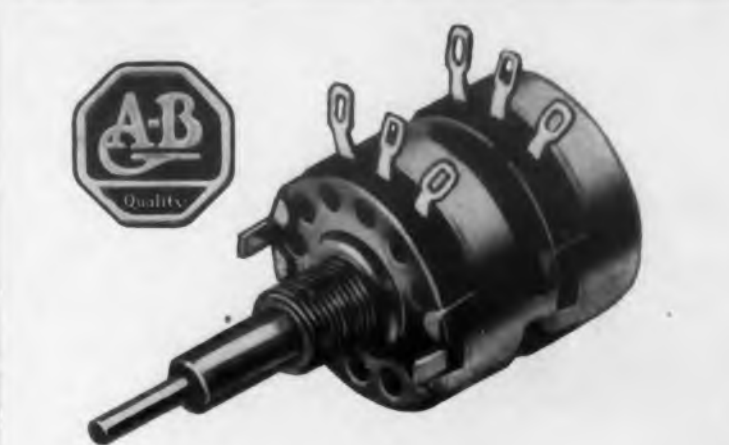
Type J single-unit resistor with plain, short shaft



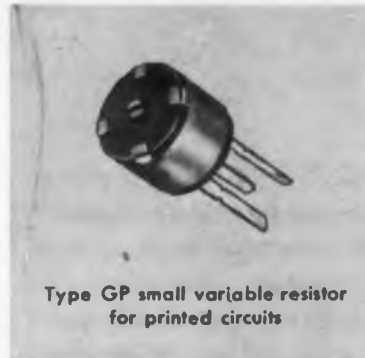
Type J triple-unit resistor



Type J single-unit with long shaft and 125v switch



Type J dual-unit resistor with short, flatted shaft



Type GP small variable resistor for printed circuits



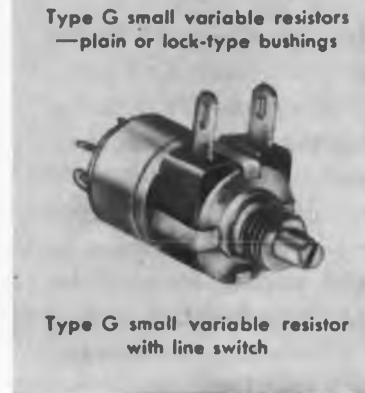
Type J single-unit variable resistor with long shaft



Type G small variable resistors—plain or lock-type bushings



Type T small variable resistors with hand or screw driver operated plastic covers—for hearing aids and similar applications



Type G small variable resistor with line switch

AN "INDUSTRY STANDARD" WHERE LONG LIFE AND QUALITY PERFORMANCE ARE NECESSARY

Here are A-B variable resistors and potentiometers that are designed for QUALITY performance. They are available in many forms and sizes.

The resistor element in all units is a solid molded ring (not paint or film) supplied for standard or special tapers. The resistance material, insulation, terminals, faceplate, and bushing are molded in ONE piece. You can expect improvement with use as brush wears smoothly to flat molded resistor. There are no welded joints, no rivets, no soldered connections.

TYPE J—2 watts—in single, dual, or triple construction. With or without line switch. Dual units can be supplied with concentric shafts for individual resistor control.

TYPE G & GP—1/2 watt—1/2 inch in diameter. Type GP units have long terminals for printed circuit applications.

TYPE T—1/2 watt—compact units for hearing aids and similar applications.

A-B variable resistors are available in standard RETMA values up to 5 megohms.

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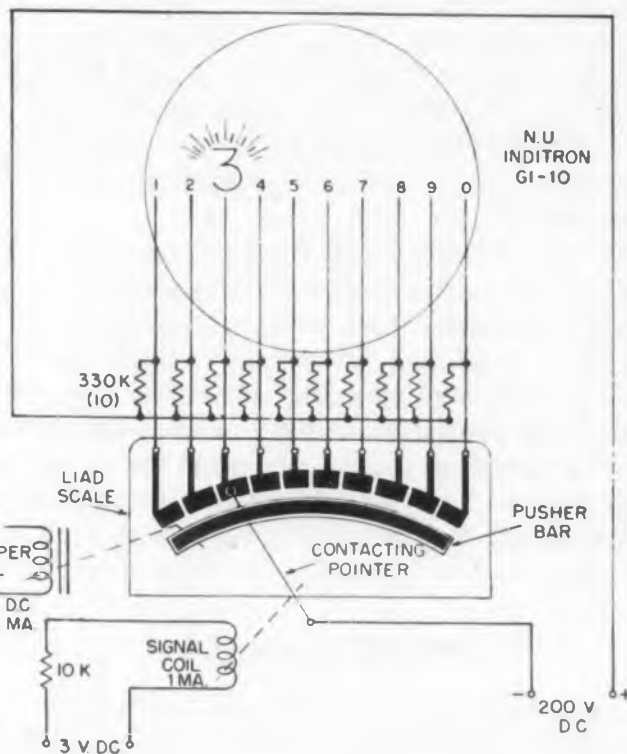


Fig. D. Schematic of an application of LIAD for direct digital readout.

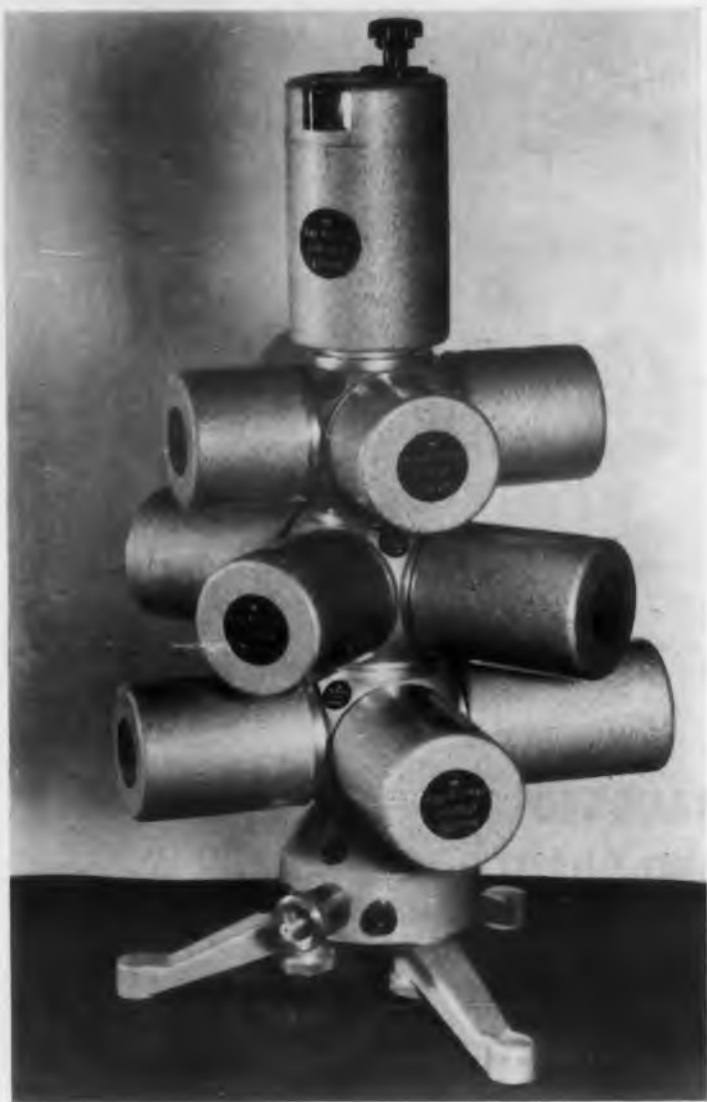


Fig. 1. Standard Capacitor. This unusual-looking standard capacitor has several special features. It is completely shielded, yet allows for the combination of as many fixed or variable capacitors as desired. The desired capacity can be obtained quickly by screwing the units into place. Because there are no connecting leads, any capacitance change introduced into the circuit by adding or subtracting a "can" is of the exact value marked on the "can." A special feature of this arrangement is the low contact resistance and the negligible inductance or capacitance introduced at point of connection. Thus, this capacitor is useful for high frequency applications.

EUROPEAN designers are challenging U.S. superiority in the field of instrumentation. Designers abroad have been remarkably successful in developing precise and versatile instruments; those which are simple to read by semi-technical personnel and which save time for engineers and production people alike. Presented here are unusual and interesting design features of some of the foreign equipment.

The following examples are selected rather arbitrarily from certain countries and fields of application in accordance with the author's own activities. One should not conclude, therefore, that interesting work is limited to specific countries such as Western Germany or to specific fields such as instrumentation.

Mechanical Design

Much attention is paid by foreign designers to the mechanical aspects of electronic equipment. One gains the impression that the design job is generally done by engineers who are as much at home in mechanical as in electronic design. Attention to styling or esthetic beauty is relatively high in importance. The concept that a well designed machine is a good looking machine is very much encouraged and is fostered by prizes given for the best combination of good styling and functional design. Fig. 1 shows a prize winning design in the form of a set of standard capacitors. This design makes possible an unlimited combination of fixed and variable capacitors with a minimum of series resistance and inductance and no lead capacitance. This results in a rather unusual looking but harmonious design.

European Instrument

Rudolf Feldt

Manager, Instrument Div.
Federal Telephone and Radio Co.
Clifton, N.J.

Space Economy

The European designer, like his American counterpart, finds his work space at a premium. An ever increasing number of instruments are needed for his work. Instruments are usually piled on top of one another or put on racks. Rack mounting, however, is only practical for specialized equipment because it ties up the equipment permanently. Piling up instruments on work benches is messy and often dangerous. By standardizing on cabinet sizes and by providing cups in the upper corners into which the feet of the instruments fit (Fig. 2), it is possible to mount 2, 3, or 4 instruments securely on top of each other conveniently and safely. It is interesting to note that while this design was started by one manufacturer, German industry seems to have adopted this method quite generally.

Because of limited local markets, European manufacturers must export much of their production. This entails marking of panels and preparation of instruction books in various languages, with corresponding manufacturing and inventory problems. The use of symbols on panels, understood in all languages, enabled designers to specify one panel for all markets. Such panels also often replace lengthy instructions. It is apparent that simplicity in panel lettering is an advantage that is appreciated by every user.

Simplicity of Operation

Lack of engineers and technically trained personnel is as bad in Europe as in the U.S. Yet, requirements

Designs

for precision instruments are constantly increasing. Tests performed heretofore in a relatively few laboratories are today routine in incoming inspection, quality control or even on the manufacturing line. There is a need for production-line instruments with laboratory accuracy which are simple enough in design so that they can be readily used by unskilled personnel. Such an instrument is shown in Fig. 3. It is a Maxwell Bridge for the measurement of inductance, series resistance, capacitance, and parallel conductance. The decimal point automatically shows as a white dot, and the unit of measurement (henrys, ohms, microfarads, megohms, etc.) is read directly through the window at the right of the numerical value. Calculations, with their inherent possibilities for errors, are thus completely eliminated.

The Wheatstone Bridge shown in Fig. 4 has similar features. In this instrument, the decimal points and units window are illuminated. The bridge covers an unusually wide range (0.01 ohms to 100 megohms) and has an accuracy of 0.1%. It is thus an instrument which combines laboratory accuracy with industrial design.

The diagraph shown in Fig. 5 directly plots impedance vs frequency on a Smith Chart, Carter Chart, Polar Diagram or other standard form. Since no calculating is required, what would normally be hours of engineering work is reduced to minutes of work by a technician.

Human Engineered

Another example of an interesting foreign design is the Audio Frequency Spectrograph, shown in Fig. 6.

Fig. 2. Direct Capacitance Meter. Common with many European instruments is the placement of a schematic on the front panel to show the user how to make connections. On this instrument the meter has two arrows, one blue and one red, pointing in opposite directions. These colors correspond to the colors on the two knobs marked "Adjustment 1" and "Adjustment 2." In operation the knobs are adjusted for maximum meter indication in the direction corresponding to the arrow of the same color. A recessed neon pilot light is used (lower right) in place of the usual incandescent lamp plus colored lens. Note the use of buttons on top to receive the mounting feet of other instruments when stacking one above the other. This avoids any possibility of stacked instruments falling and being damaged.



Fig. 3. L-C Precision Bridge. Many instruments of European design feature the use of symbols (lower right) to show application and proper connection to the instrument. An external null detector is used with this instrument. As the bridge is adjusted to balance, the inductance or capacitance and resistance values appear in digital form in the windows of the panel. In addition, the decimal point automatically appears in small holes between the knobs. D-C current can be conveniently passed through the test coil to simulate actual operating conditions by applying d-c voltage to the upper terminals marked "DC Magnetisation."



Fig. 4. Precision Meter. Like the L-C Precision Bridge, the R-Precision Meter gives results in digital form without the need for further calculation. However, in this instrument the decimal point lights up as well as the units symbol at the upper right. Heavy spring loaded terminal clamps (lower center) insure low resistance connection of leads or banana plugs.





Fig. 5. Z-g Diagraph. This is an impedance measuring device which gives answers directly on a Smith Chart without the need for calculation. A blank Smith Chart is inserted onto the "face" of the instrument. A spot of light appears at the appropriate point of the chart to survey the data desired. The chart can be marked with pencil or pen accordingly to give a permanent record for reference. A photographic record can be made of the chart with light spot superimposed, if desired. A technician can obtain data with this instrument that otherwise requires the skill of an engineer.



Fig. 6. Audio Frequency Spectrograph. This instrument analyzes the spectrum, from 20cy to 20kc. Unusually high resolution is provided, with selectivity of 10cy or 200cy available as desired. An 80db signal difference can be detected. An especially interesting feature is the method of data presentation. Graph paper can be inserted from the top of the chart frame provided and readily removed from the bottom by pushing appropriate buttons on the panel. An ink recorder automatically traces the pattern over any selected 5kc band.

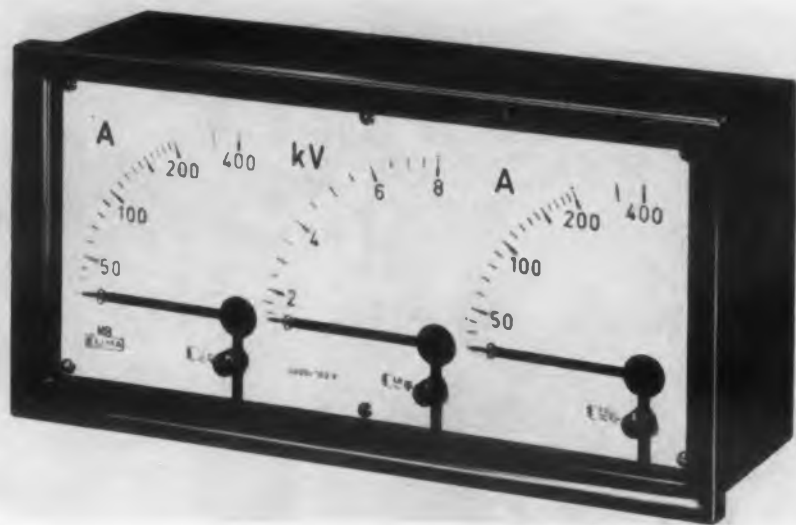


Fig. 7. Quadrant Meter. With this quadrant meter a "full scale" reading is indicated by a vertical position of the needle while for "no reading" the needle is in horizontal position. When the meters are grouped in a bank, this arrangement makes for extremely easy reading. Also, for a given scale size, the meters can be made smaller this way. The arc is the smallest one that can be fitted inside a square.



It automatically plots line spectra of such phenomena as noise, vibration, etc., with utmost accuracy and convenience. At the touch of a button, paper is inserted under the ink stylus and removed as easily by touching another button.

In Europe there are some very interesting and radical departures from established meter design practices. One example is shown in Fig. 7. Two advantages are claimed for this design; the longest possible scale obtains for a square meter; and zero and full scale readings are easier to spot, particularly on large panels containing many meters.

Laboratory precision meters also feature interesting design; most are now being built as shown in Fig. 8 with a "light pointer" instead of a needle, and with curved scales to minimize errors. Advantages claimed for the "light pointer" are: greater resistance to damage, no parallax error, and no need for illuminated scale. A meter built in accordance with this same principle has recently been announced by an American manufacturer.

Economy of Operation

Since electric power is considerably more expensive in Europe than in the U.S., much attention is paid to economical design from an operational standpoint. It is not unusual to find equipment which requires less than half the power drawn by comparable equipment of U.S. manufacture. Apparently, this is not done at the expense of good regulation.

As much attention is commonly paid to what is behind the panel or in the cabinet as to external appearance and operating features. Every effort is made to reduce the "down time" for maintenance. High quality conservatively rated parts are used. In Fig. 9 is an example of a mechanical chassis design that aids in maintenance. What is behind the panel is as neat and business-like in appearance as the panel itself. The entire equipment is designed to last almost indefinitely, to require a minimum of maintenance and above all, to save the valuable time of the designer or technician who might use it.

For many design applications it is necessary to have the very best test equipment available in accuracy, versatility, readability, and reliability. Many times a design is limited by the available instruments (tools) for checking it out. Certainly, valuable engineering time is often wasted using make-shift methods and in checking test equipment for proper operation. Where "only the best" is good enough, designers should have the best possible tools with which to do their best work. In seeking such tools, all sources should be checked; and European or other foreign instruments should not be overlooked.

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Fig. 8. Light Spot Watt Meter. This Hartmann and Braun design eliminates the needle pointer common to galvanometer type instruments. Several interesting advantages result. By focusing a light spot onto a mirror affixed to the moving coil, scale illumination follows coil movement. No external illumination is necessary to read the meter. An important feature is that there is no parallax since the cross-hair in the light beam appears directly on the scale. Meter sensitivity can be greater because less force is necessary to move the coil than when a needle pointer is attached. Also, there is no mechanical damage to the instrument on overload. The light beam will move off scale but there is no needle to "wrap around the pin."

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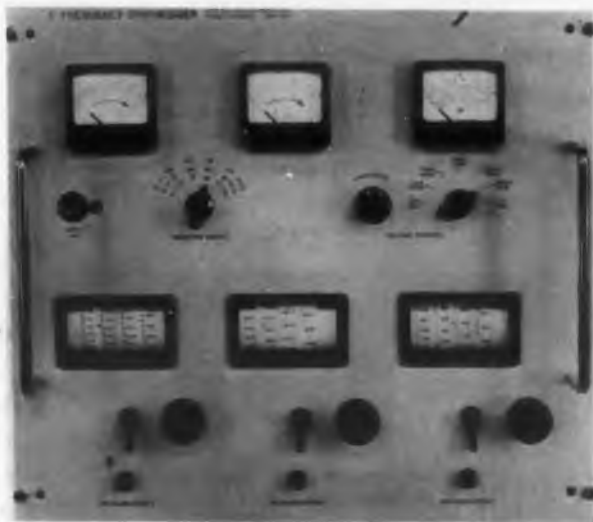
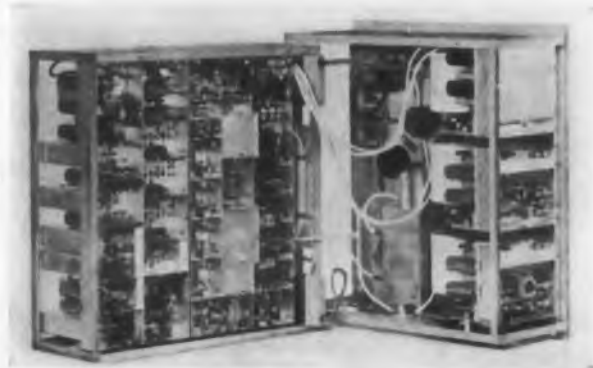


Fig. 9. Frequency Synthesizer. Essentially all information necessary for using this instrument is incorporated on the panel; yet, it appears uncluttered. The pointers on the frequency scales move horizontally as the drum dials are rotated to indicate at all times which scales are to be read. The markings above the Selector Switch indicate which frequencies are "locked in" with the crystal and which are continuously variable. The half moon above the voltage dial indicates the direction of "crescendo" or increased amplitude. The rear view shows how carefully the instrument is constructed. The mechanical layout and design facilitates ease of testing and maintenance.





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R 809**



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SIZE 10	.30 OZ. IN.	8500	23/1	.5%
NEW R 809	.63 OZ. IN.	5900	25/1	.5%
SIZE 15	1.5 OZ. IN.	5000	25/1	.5%
SIZE 18	2.4 OZ. IN.	5000	25/1	.5%
SIZE 18	3.0 OZ. IN.	9600	23/1	.5%
RATE				
SIZE 15	.45 OZ. IN.	10,500	170/1	.5%
SIZE 15	1.5 OZ. IN.	4700	350/1	.2%
SIZE 18	2.4 OZ. IN.	4700	350/1	.2%
SIZE 18	3.0 OZ. IN.	8400	350/1	.2%
*INTEGRATOR				
SIZE 15	.70 OZ. IN.	6300	400/1	.1%
SIZE 15	1.25 OZ. IN.	4500	400/1	.1%
SIZE 18	1.35 OZ. IN.	7200	400/1	.1%
SIZE 18	2.4 OZ. IN.	5200	333/1	.06%
SIZE 18	3.0 OZ. IN.	8000	333/1	.06%

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SILICON DIODE**

*High peak inverse
voltages... extremely
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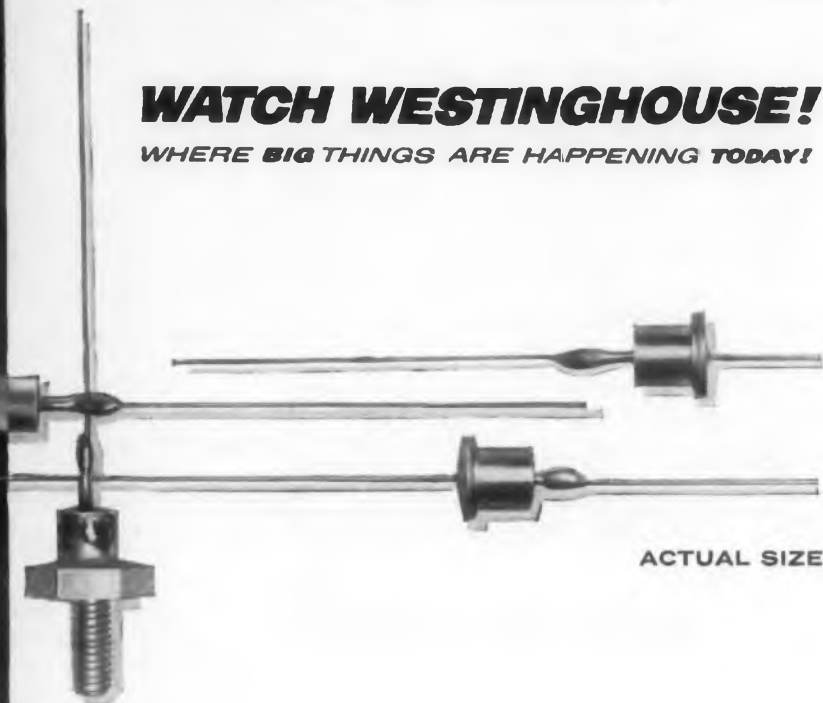
The Westinghouse XP-5052 fused-junction silicon diode can handle 500 ma continuous d-c current at peak inverse voltages from 50 to 600 volts.

Leakage at rated voltage is extremely low... result is increased efficiency and temperature ranges never before attainable.

This diode is suitable for use in radio and TV, radar, aircraft, magnetic amplifiers, voltage regulators, computers, precipitators, and other industrial applications. Two case designs are immediately available... pigtail (XP-5052) and threaded stud (XP-5053).

For more information on the XP-5052, or any other silicon rectifier requirements, regardless of voltage and current, call your nearest Westinghouse apparatus sales office, or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-09001

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CIRCLE 34 ON READER-SERVICE CARD FOR MORE INFORMATION

Quadruple Pulse Generator

CALIBRATION and testing of many pulse systems require a series of pulse trains of variable amplitude and width. Coincidence equipment found in computers and nuclear counters are two of the possible applications of multi-pulse test equipment.

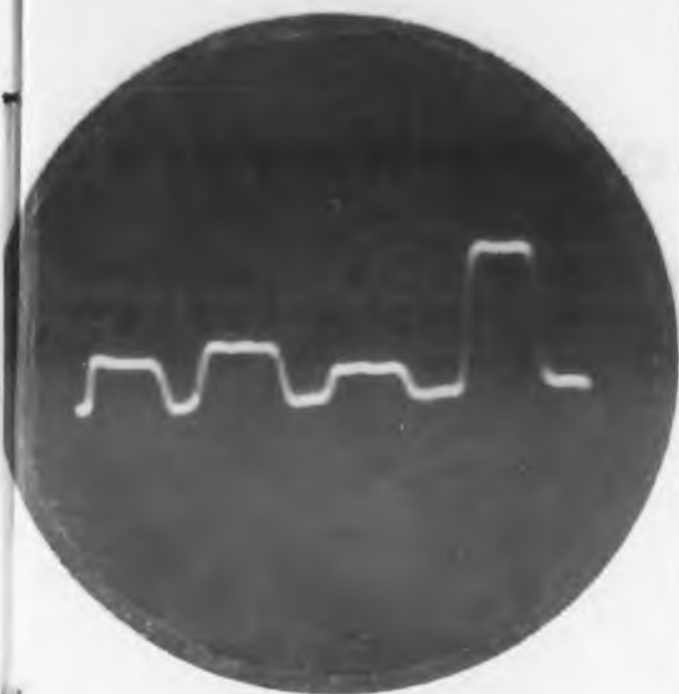
Four square-wave pulses of less than 1milli- μ sec rise time are generated by this newly developed pulse generator. Pulse width may be varied from 0.001 to 0.1 μ sec. Additional plug-in delay lines may be used with the instrument to attain pulse widths up to several microseconds.

Separate panel jacks are provided for each of the four outputs. Amplitude of each may be



Multiple generator showing attenuator switches for each of four outputs. All outputs may be mixed if desired.

ELECTRONIC DESIGN • July 15, 1956



Typical pulse train at a sweep speed of 50milli- μ sec per cm and a vertical amplifier rise time of 7milli- μ sec. Pulse widths are 50milli- μ sec. Spacing is 30milli- μ sec between the first and second, 35milli- μ sec between the second and third, and 50milli- μ sec between the third and fourth pulses.

varied in 1 db steps from 0.006 to 100v by means of toggle switches. Nominal output impedance is 75 ohms. Amplitude range is from 0.004 to 66v into 50 ohm cable. A continuously variable attenuator permits finer control if desired. A polarity switch is also provided.

All outputs are simultaneous in time to within 0.1milli- μ sec. Pulses can be used separately or individually delayed, then mixed into a common pulse train.

Among the applications for this unit, made by Electrical & Physical Instrument Corp., 25 W. 43rd St., New York 36, N. Y., is the calibration of oscilloscope horizontal sweep deflection as a function of time. This calibration depends only upon accurate measurement of length and velocity of propagation of the coaxial cable delay line.

Vertical deflection as a function of pulse amplitude as well as rise time and distortion of vertical amplifiers may also be measured.

Multipulse resolution and behavior of fast counting devices, such as scalars and beam switching tubes can be determined using multiple pulse trains of various amplitudes and widths. Another application involves observation of transient response of diodes and transistors. For more information on this multiple generator, turn to Reader's Service Card and circle No. 35.



Is a SPDT switch worth \$60.50?

Yes . . .

when it's a Brown non-loading, electronic **Electr-O-Vane** unit

YOU'LL find this high-precision electronic switch useful in scores of applications. Less than 2 gram-inches of force actuates it. Switching action occurs with only 0.003" movement of the vane member . . . always occurs at precisely the same spot.

Use the *Electr-O-Vane* unit—

in machine tools—as a non-loading limit switch

in automatic weighing equipment—as a cut-off switch

in process equipment—as a no-load safety switch

under conveyor belts—for accurate counting without contact

—and in many other places where you want precision switching with minimum force.

The *Electr-O-Vane* unit has a thin metal vane which moves between a pair of coils in a stable electronic circuit. Movement of the vane starts and stops oscillation . . . actuates a load relay. No extra effort is needed at the switching point . . . no "bump" in action . . . no electrical connection to the moving member . . . no chatter.

The unit is compact, sturdy . . . mounts in any position. Its actuating arm can be set to provide switching at any point within a 260-degree arc.

ORDER NOW . . . prices from \$60.50 (even more favorable on quantity orders). Prompt quotation and delivery. MINNEAPOLIS-HONEYWELL REGULATOR Co., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa. —in Canada, Toronto 17, Ontario.

SPECIFICATIONS

Force to move vane	2 gram-inches max.	Load relay rating	115 volts, 6 amp. a-c, non-inductive load
Vane motion for snap action	0.003 in.	Operating power	115 volts, 50-60 cycles. Also 230 volt model
Precision	within 0.002 in.		
Switch action	SPDT, when vane centerline approx. 41° left of vertical		

● REFERENCE DATA: Write for Specifications 911-1.

Prices and specifications subject to change without notice.



Electronik NULL INDICATOR

The modern successor to the spotlight galvanometer. Ideal for lab or production testing. Immune to vibration . . . self-protecting against overloads . . . needs no leveling. Just plug into 115-volt a-c line. Sensitivity .001 microamp or 1 microvolt per division. Price: \$175.00 F.O.B. Philadelphia. Write for Data Sheet No. 10.0-12.



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Transformer Odd-Impedance

OCCASIONALLY the need arises for an impedance transformer which will match a given generator to an unusual value of load impedance. If commercial transformers with appropriately rated impedance taps are not available, advantage can often be taken of the unrated odd impedances between various secondary taps of multiple winding transformers when the impedance values between the different taps and common are known.

The nomograph for finding these odd impedances can be used to save time in determining these values and is based on the following calculations:

Referring to the figure, it is assumed that impedances Z_1 and Z_2 are known, but that impedance $Z_{(2-1)}$ is unknown.

Basic transformer theory tells us that:

$$\frac{Z_1}{N_1^2} = \frac{Z_2}{N_2^2} \quad (1)$$

from (1) $N_2^2 = N_1^2 \frac{Z_2}{Z_1}$

$$N_2 = N_1 \sqrt{\frac{Z_2}{Z_1}} \quad (2)$$

Similarly: $\frac{Z_1}{N_1^2} = \frac{Z_{(2-1)}}{(N_2 - N_1)^2} \quad (3)$

Substitute (2) in (3) and solve for $Z_{(2-1)}$

$$\begin{aligned} Z_{(2-1)} &= Z_1 \frac{N_1^2 \left[N_1 \sqrt{\frac{Z_2}{Z_1}} - N_1 \right]^2}{N_1^2} \\ &= Z_1 \left[\sqrt{\frac{Z_2}{Z_1}} - 1 \right]^2 \quad (4) \end{aligned}$$

Algebraically, this may be written as

$$Z_{(2-1)} = (\sqrt{Z_2} - \sqrt{Z_1})^2 \quad (5)$$

Nomograph

R. W. Thorpe

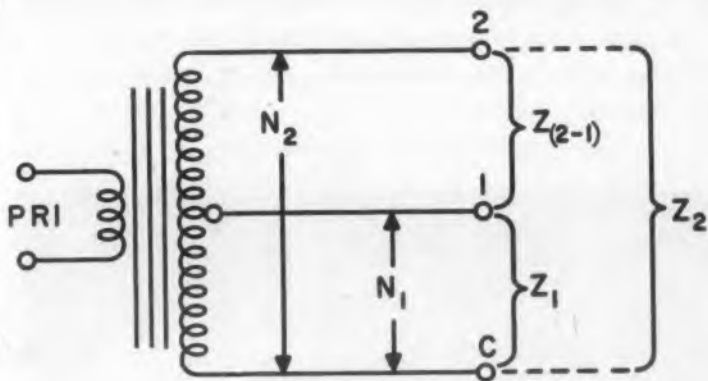
Development Engineer

Associated Missile Products Corp.

Subsidiary of American Machine & Foundry Co.

Pomona, Calif.

If the primary winding is improperly matched, each secondary impedance must be multiplied by the mismatch factor of the primary impedance. It should be noted, however, that a transformer operated at impedances distinctly different from those for which it is rated may have undesirable performance characteristics even though the turns ratio is correct for the application.

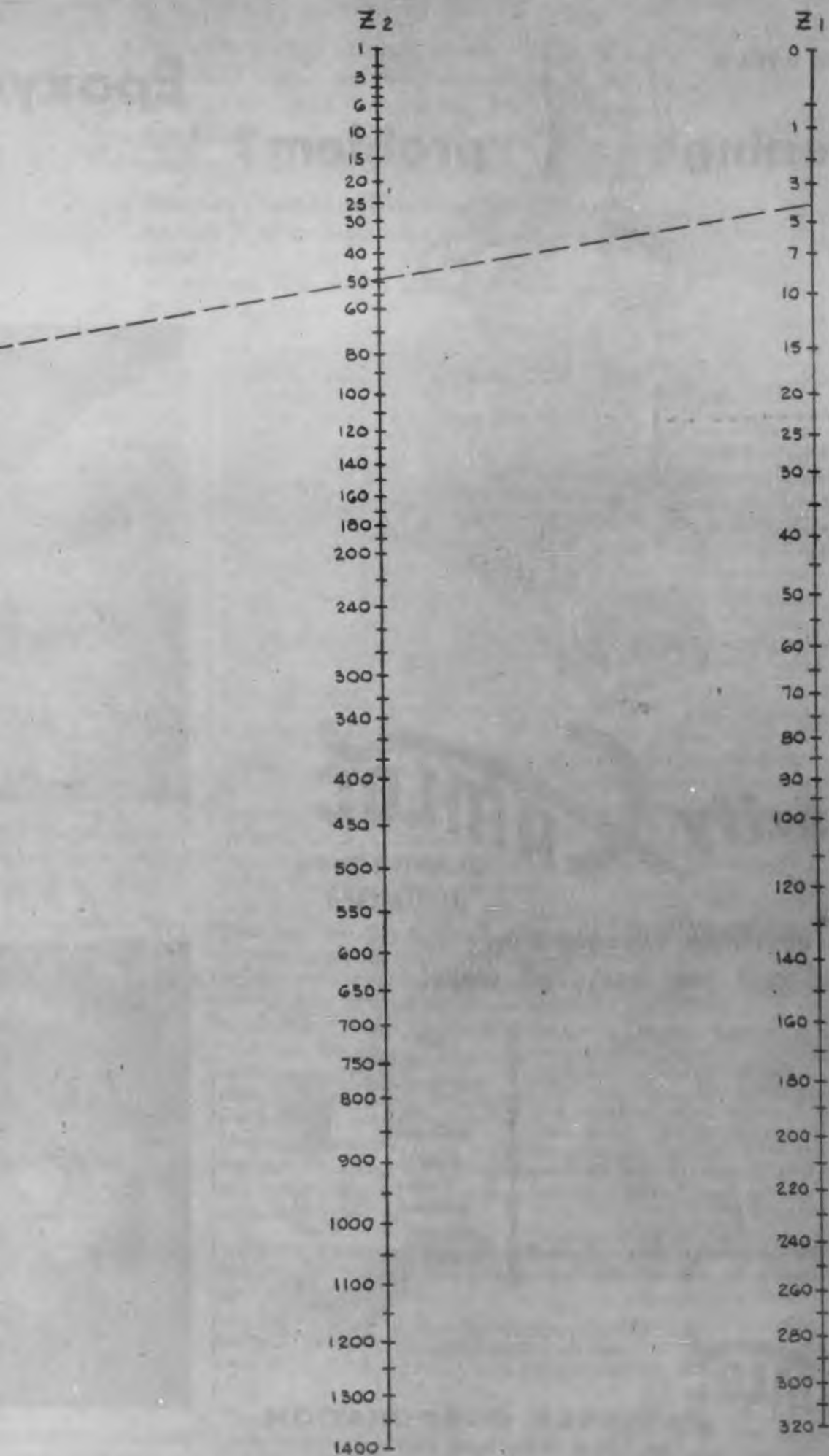


Example

As an example of nomograph use, assume a transformer with 500-ohm primary is available having secondary taps of 4 and 50 ohms. The impedance between these taps is unknown. By laying a straight-edge across the nomograph, a line is drawn between the 4-ohm point on the Z_1 scale and 50-ohm point on the Z_2 scale. The line crosses the $Z_{(2-1)}$ scale at 25 ohms. Thus, the unknown impedance is 25 ohms. The impedance step-down is 500:25 or 20-1.

$Z_{(2-1)}$





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Epoxy-Resin Tape Insulation



Electronic capacitors may be insulated with a cigarette wrap of epoxy-resin tape. The tape forms a cylinder around the body of the capacitor and is cured to form a waterproof sheath. Ends of the capacitor are then sealed by pouring them full of liquid resin.



Shown here is epoxy-resin tape X-1045—a non-woven polyester mat impregnated with epoxy resin—being applied to a motor coil. The fully wrapped coil is cured and pressed to provide a smooth hard surface which is shaped to fit snugly in its slots.

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EPOXY-RESIN impregnated glass cloth and non-woven polyester mat insulation tapes are now commercially available for the first time. Such tapes have the advantages associated with epoxy resins, including high dielectric strength, high resistivity, mechanical strength, chemical resistance, excellent adhesion to glass, metals and other materials, resistance to thermal degradation, and no voids or fissures.

The two types of epoxy resin tapes, manufactured under the brand name "Scotchcast," are type X-1035, a 4-mil glass cloth coated with 14 mils of epoxy resin, and type X-1045, a polyester mat also coated to a nominal thickness of 14 mils. The manufacturer is Minnesota Mining and Manufacturing Co., 900 Fauquier St., St. Paul 6, Minn. The tapes meet class B electrical insulation performances requirements and can be used for such purposes as: insulation of coils and conductors, insulating motor or generator field windings, wrapping toroidal windings, forming L and V shaped channels, anchoring transformer leads, as transformer outer covers, and as inter-layer and inter-winding transformer insulation.

Both epoxy resin tapes have a dielectric strength of 1000v per mil and a volume resistivity of 10^{12} ohms at 96% RH. A paper liner strips off the tape before use. The tapes feel smooth and plastic at room temperature but leave no residue or pigment on the hands of the workers.

On application, the tape can be elongated up to 45%, allowing for shrinkage on cure to permit a tight bond for the wire or material to which it is applied.

Some specific electronic applications include a "cigarette wrap" sleeve of epoxy resin tape around capacitors. The ends are sealed with an epoxy resin. When cured, a moisture resistant covering with good electrical properties results. Another application is the use of Tape X-1045 to wrap transformer coils. When cured, two holes are punched in the tape; resin is squirted through one hole using a pressure gun to impregnate the coil, with the other hole providing an outlet for trapped air.

Necessary electrical insulation on a small heat-sensitive bi-metallic relay is satisfactorily provided with epoxy-resin tape because of its ability to withstand the high operating temperatures. For another application, several layers of X-1035 tape have been laid flat and cured to make a base for printed circuits; these can then be molded to conform to irregular contours. The tapes have also been cured in layers, shaped to make coil forms. Such forms will not absorb moisture, a common fault with the paper often used for this purpose.

For additional information on this product, fill out the Reader's Service Card and circle No. 40.

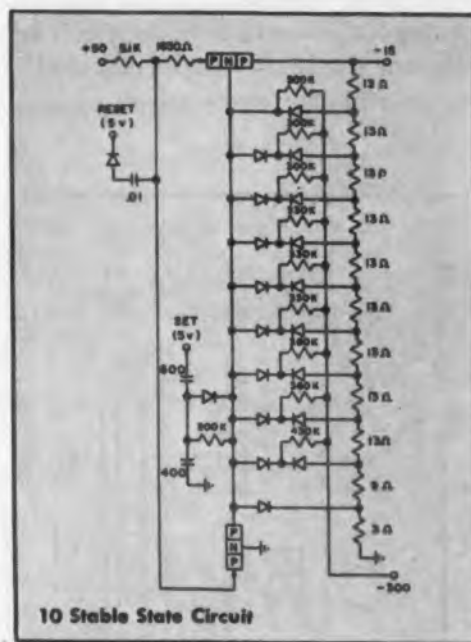
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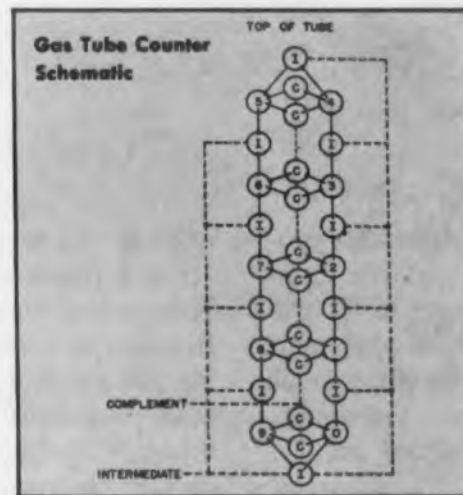
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Multi-Stable Work Horse

As the size and complexity of IBM products increase, we are faced with growing numbers of components—which means increased cost. As part of our continuous search for improvement and ways to reduce the number of components, Robert Henle, one of our Transistor Circuit Research people, undertook to get more work out of a given number of transistors. The result is a two-transistor, multi-stable circuit employing feedback controlled by a non-linear load. Junction transistors are naturally suited to this new kind of circuit.



A full report on this new idea from IBM contains eight full-page circuit diagrams in addition to mathematical analyses of the operation of the circuit. Write for your copy of IBM Bulletin No. 200.



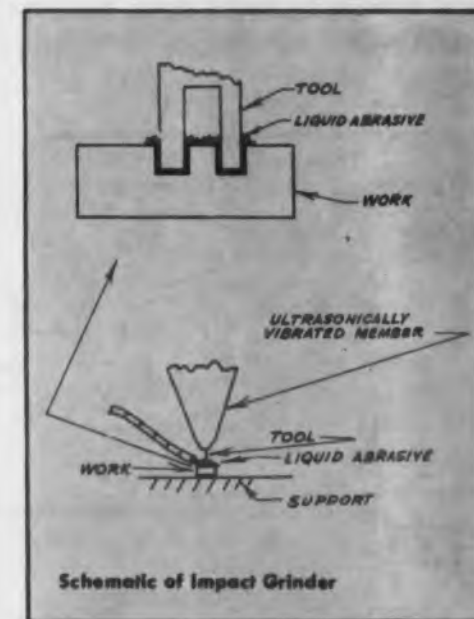
Self-Complementary

Accounting machines these days must be able to do everything—even make decisions. In order to get a machine to do more in a day's time with little or no increase in operating cost, IBM Component Research people studied the idea of using a multi-cathode gas tube. It's good news that they came up with an attractive approach, which Robert Koehler, of our Device Development Group, then reduced to practice; it operates faster than its electro-mechanical predecessor and, furthermore, with simple circuitry, can subtract by adding. It can read out in true number form both positive and negative balances. This is possible because a number stored in the tube may be transposed to its 9's complement (i.e., value subtracted from nine) by a single electrical pulse.

If you'd like more information on the basic principle, physical arrangement of parts, and typical problems solved, write for IBM Bulletin No. 201. If you are fascinated by the theory of numbers, we recommend this Bulletin.

The Soft Touch

In some of our studies of new components, at the IBM Research Laboratories at Poughkeepsie, it is necessary to make many different, small and intricately shaped parts from brittle materials. Following the conventional approach, each of these parts would require laborious and costly machining and fabrication. We turned to ultrasonic cutting; with this tool we can make any shape or size component in approximately a minute—with an accuracy five times greater than previously possible! The ultrasonic cutter has helped us progress faster in our development of new devices. RESEARCH at IBM means IDEAS at work.



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New models are being released daily—just recently a 4-transistor handle-carried set by Olympic has been announced. The table includes only those models for which information was received in time for publication.

Current Trends in Transistor Radios

Sol D. Prenskey

THIS year's growth in the use of transistors has produced a fine crop of all-transistor portable radio sets that cannot fail to impress observers—from the design engineer right down to the ultimate consumer. Practically everyone has become conscious of the great variety of portables in all sorts of sizes: wrist-radios, pocket-size sets, and the larger handle-carried sets. To these are added, the recently announced transistorized automobile radios and portable phono players.

We have tabulated here a description of the receivers not only to show the type number and function of the transistors being used, but also to emphasize the outstanding advantages that these new sets have to

offer in the way of their compact size and their increased practicality obtained from the use of lower-voltage and longer life batteries. The use of mercury batteries in many cases has not only increased operating life to the point where battery replacement is no longer necessary during the entire summer season, but it has also broken through the "shelf-life" deterioration barrier, that previously made it impractical to keep a set of reserve batteries on hand. A mercury battery-pack has the unique property that after a full year of non-use, it can still be depended upon to be as much as 97% fresh. Additionally, for the highly important civil-defense use, it is now possible for everyone owning a

model to keep an extra mercury battery in reserve, and thus have a truly practical "Alert-ready" receiver that will be ready, whenever needed, (within any given year), to work on either its operating battery or on its entirely-dependable reserve supply.

From the standpoint of transistor receiver-circuit design, much development has taken place in the availability of the special items, such as antenna, oscillator, and i-f transformers and other components that adapt the widely used superhet circuit to transistor operation. Various new transistor types have come into use. The schematic diagrams of Figs. 1, 2, and 3 show representative circuits where use has been made of special

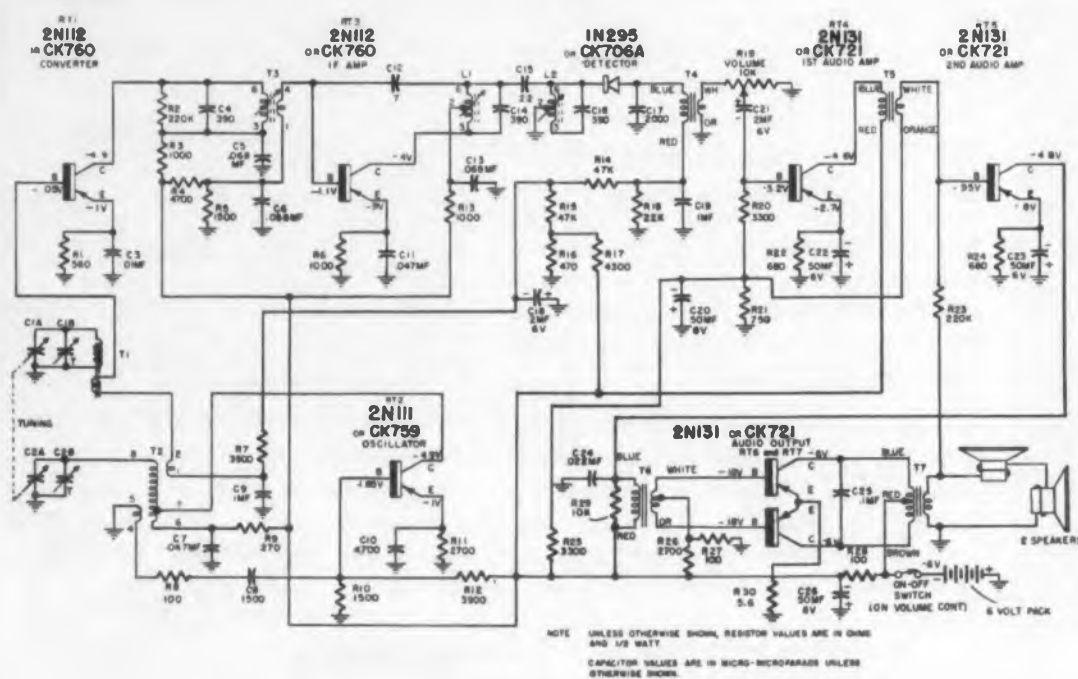


Fig. 1. Schematic diagram of 7-transistor chassis by Raytheon (T-2500) uses all p-n-p transistors.

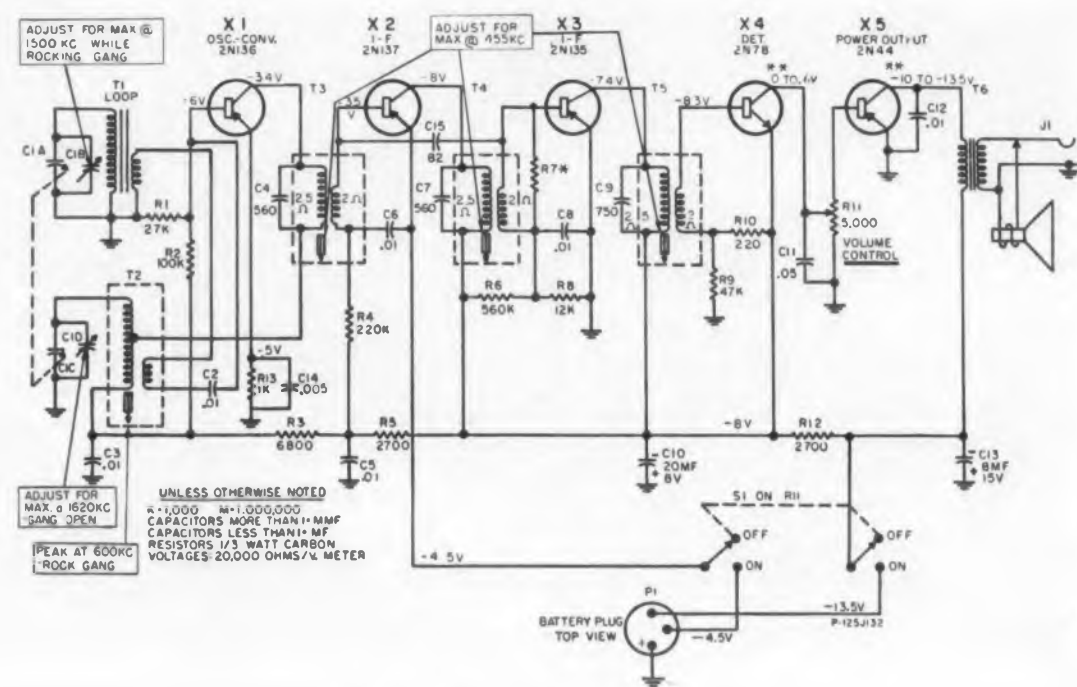


Fig. 2. Five transistor circuit uses n-p-n detector (G.E. models 675 & 6).

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MANUFACTURER AND MODEL	OSC.-MIXER (CONVERTER)	TRANSISTOR COMPLEMENT				AUDIO OUTPUT	TOTAL
		IF	DET.	AMP.			
Admiral with "Sunpower Pack"							6
Capehart- Farnsworth 11P7	(1) CK760 or 2N112	1st CK760A 2nd CK760A	(1N295) (Diode)	2N132	(2) 2N138 (Push-Pull)	6 + Diode	
CBS-Columbia 250	(1) 2N136	1st 2N135 2nd 2N135	2N135		2N44	5	
CBS-Columbia 260	(1) 2N172	1st 2N146 2nd 2N146	1N60 (Diode)	T1310	(2) T1352/ 2N185, P-P	6 + 2 Diodes	
Crosley JMB (Hybrid Type)	(1) Tube (1V6)	Tube (1AH4)	Tube (1AJ5)		(2) 2N109 (Push-Pull)	2 + 3 Tubes	
Dewald K544	(1) CK760 or 2N112	(1) CK760A or 2N112A	(1N295) (Diode)	2N132	2N138	4 + Diode	
Dewald 701	(1) 2N112	(2) 2N112	1N295 Diode	(1) 2N109	(2) 2N109	6 + Diode	
Dewald K702B	(1) 2N112	1st 2N112A 2nd 2N112A	(1N295) (Diode)	2N132	(2) 2N138 (Push-Pull)	6 + Diode	
Emerson 838 (Hybrid Type)	(1 Tube) (1V6)	(Tube) (1AH4)	(Tube) (1AJ5)		(2) Emerson #815003	2 + 3 Tubes	
General Electric 675-6	(1) 2N136	1st 2N137 2nd 2N135	2N78		2N44	5 Tr	
Motorola Auto Radios		5 and 8 Tube Models Plus Power Transistors			2N14	1 + 5-8 Tubes	
Lel 125	regenerative		(1)	(1)	(1)	3	
Magnavox AM-2	2N192	1st 2N146 2nd 2N147	Diode	310	2N185 (Push-Pull)	7 + Diode	
Motorola 56T	2N172	1st & 2nd 2N145/6/7	R35		2N185		
Philco T-7	(1) L5113	1st L5114 2nd L5114	L5113	L5021	(2) L5028, Matched Pair of L5024	7	
Philco Auto Radio (Search Type)	(1) L5113	1st L5114 2nd L5123	L5113	L5113 & AR2	(2) AR 1 (Push-Pull)	11 (Note)	
Philco Phonograph Amplifier TPA-1	Uses Type L5021 Driver, and Two Type L5022 in Push-Pull Output.						
PYE	V6/R3	V6/R3	V6/R2	V10/30A	(2) V10/30A	8	
Pam 710	V6/R3M	V6/R3					
Raytheon T-100	(1) CK760 (or 2N112)	CK760 (or 2N112)	CK706A	2N132	(1) 2N138	4 + Diode	
Raytheon T-150	(1) CK760 (or 2N112)	1st CK760 2nd CK760	CK706A	2N132	(2) 2N138 Push-Pull	6 + Diode	
Raytheon T-500	Osc-CK760 Mix-CK759	CK760 or 2N112	CK706A	1st CK721 2nd CK721	(2) CK721 or 2N131	7 + Diode	
Raytheon T-2500	Osc-CK759 Mix-CK760	CK760	1N295	1st CK721 2nd CK721	(2) CK721 Push-Pull	7 + Diode	
RCA 7-BT-9J	(1) Type 235	1st Type 234 2nd Type 234	1N295	2N109	(2) 2N109 Push-Pull	6 + Diode	
RCA 7-BT-10K	(1) Type 235	1st Type 234 2nd Type 234	1N295	1st 2N109 2nd 2N109	(2) 2N109 Push-Pull	7 + Diode	
Regency TR-1G	(1) 2N172	1st R10-2 2nd R10-2	Diode		(1) R-11	4 + Diode	
Regency TR-6	(1) 2N172	1st R26-2 2nd R26-2	Diode	Type 310	(2) Type 353 Push-Pull	6 + Diode	
Roland	(1) GT761	1st GT760 2nd GT760	1N60	GT20	2 GT20 Push-Pull	6 + Diode	
Westinghouse 58 P Series						7	
Zenith 500	Osc-2N94	1st 2N94	Diode	2N35	(2) 2N35	7 +	
7xT40 Chassis	Mix-2N94	2nd 2N94			Push-Pull	Diode	
Zenith 7xT40Z Chassis	(2) CK760	(2) CK759 or (2) 2N111	Diode	2N132	(2) 2N138	"	

SPEAKER SIZE (in.)	BATTERIES		APPROX. LIFE (hrs.)	SIZE OF SET (in.)	NOTES
	VOLTS	TYPE			
4	32-cell silicon 9	solar battery dry	Life 1,000	10x3-1/4x7-1/4	Details not yet announced.
2-3/4	12-21	dry	75	5-1/2x3-1/4x 1-5/8	
6 x 9	9	dry	1,500	9-1/4x12-3/4x 6-1/4	Additional AVC, Diode
2-3/4	4 45 9	merc dry dry	45 90	7x4-1/2x1-7/8	Book cover is on-off switch
	9	dry			Similar to K702B
2-3/4	4 45	merc dry	45 90		Matched pair Class B output
2-3/4	13.5	dry		5-5/8x3-3/16x 1-1/2	Speaker 16 ohm v.c.
6 x 9	12				
None	6	merc dry	100	2-3/4x1-3/4x 3/4	Wrist band or pocket clip.
2-3/4	4		200	5-3/4x3-1/4x 1-9/16	
2-3/4	9	merc dry	100	5-1/2x3-5/8x 1-5/8	
2-3/4	3	dry	250	7x4-3/4x2	
7	12				Includes rf stage L5113
7	6	dry	300	9x7x3-1/2	100mw output, 30 ohm v.c.
2-3/4	9	dry	100	6-1/4x3-3/8x 1-3/4	British unit 315kc i-f
2-3/4	9	dry	150	6-1/4x3-3/8x 1-3/4	20mw output, 15 ohm v.c.
3-1/2	6	merc dry	500 to 2500	9-1/2x7x2-3/4	50mw output, 15 ohm v.c.
Dual 5-1/4	6	dry	2500	12-1/2x8-1/2x 5-3/4	100mw output, dual speakers (see schematic)
2-3/4	9	dry	75	5-13/16x3-7/16x 1-9/16	High min vol level used as reminder to turn set off.
4 x 6	9	dry	500	10x7-1/4x4	Dual-pot vol control; (see schematic).
2-3/4	22.5	dry	30 to 50	5x3x1-1/4	Lt wt (12oz)
4	9	dry	500 to 1000	6-3/4x5x3	Home-portable type.
4	9	merc	500	5x3-1/2x1-1/2	Ferrite loop antenna.
2-3/4	9			6x3-1/8x1-5/8	Details not yet announced.
2-3/4	6	dry merc	100 400	5-3/4x3-1/2x 1-1/2	All three chassis produced as model 500
**	**	**	**	**	**



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than 4/10 ounce in weight . . . and precise stable adjustment with a 25-turn, stainless-steel lead screw.

RWT provides standard temperature range from -55°C to $+95^{\circ}\text{C}$. . . wide resistance range from 50 to 20K ohms . . . and a power rating of 2 watts at 25°C derated to 1/4 watt at 95°C . Special units are also available for operation up to $+145^{\circ}\text{C}$ and power ratings up to 1/4 watt at 125°C .

For complete specifications on the RWT request Bulletin TP-200.

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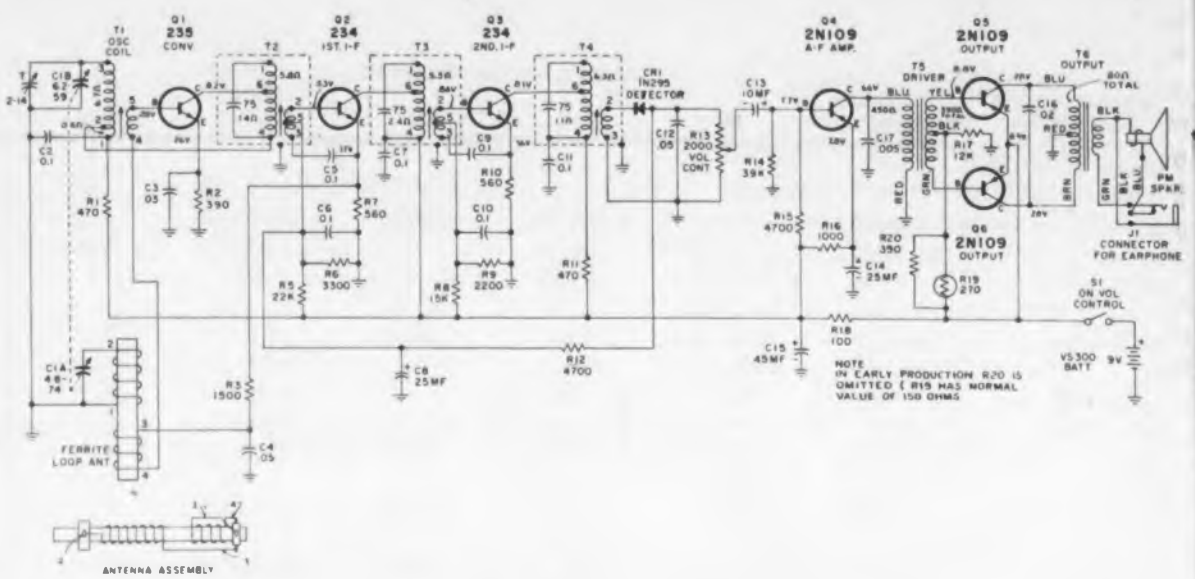


Fig. 3. This pocket radio schematic uses 3 n-p-n and 3 p-n-p transistors (RCA 7-BT-9J). Compactness of set is illustrated in photograph below.



Wrist model (somewhat king-sized) of LEL, Co-piague, N. Y. uses regenerative circuit.



Compact small portable is illustrated well by Roland's all-transistor 66. Four-in. speaker is larger than most.

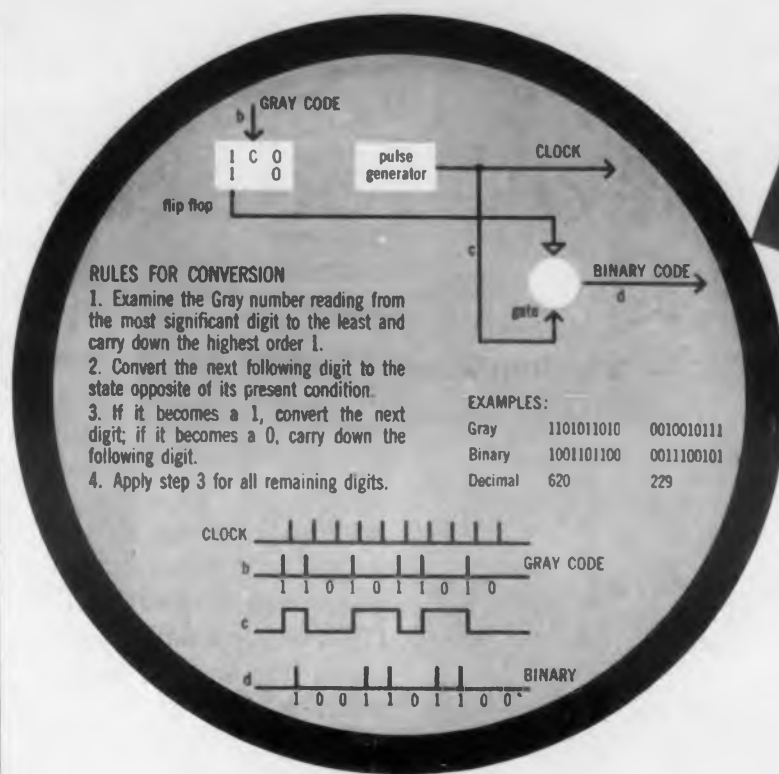
transistors (both p-n-p and n-p-n types) having specific suitability for use as oscillator mixers, i-f amplifiers, detectors and power amplifiers. The Raytheon circuit model (model T2500, chassis 7RT4) Fig. 1, uses 7 transistors (all p-n-p) and is representative of the larger (handle-carried) sets using separate transistor as an oscillator, one mixer, one i-f amplifier, a crystal diode detector, two audio amplifier stages, and a push-pull audio output stage. Fig. 2 shows the circuit used in the RCA "transistor-six" pocket-sized set (model 7-BT-0J, chassis RC-1159), which illustrates the use of three n-p-n type transistors for the r-f-i-f section and a crystal diode detector followed by an audio driver and a push pull output stage, accounting for the other three (of the p-n-p type) transistors; the provision for plugging-in a low-impedance earphone is also shown. A five-transistor complement is shown in Fig. 3 by the General Electric pocket-size set (model 675-6), which employs four p-n-p transistors for the oscillator-mixer. 1st i-f, 2nd i-f and single-ended audio output stages, while the fifth transistor for detector stage is of the n-p-n type.



Typical rectangular shaped portable is Raytheon 500 model.



This larger CBS 260 chassis is used in a transistor "home" radio which features 6"x9" oval speaker. The model 260 becomes a chair-side unit when set on its metal stand—no a-c cord, of course.



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converting Gray code to
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D-C Power Supply Dual Magnetically Regulated



Designated the Stablvolt Model MR 532-15, the unit is short circuit-proof, has excellent static and dynamic regulation and provides line transient-free d-c power.

Offering an output range of 3-36v at 15amp, the instrument features static regulation of $\pm 0.25\%$, ripple less than 50mv for the entire voltage range, dynamic regulation of less than 1% for a 10% line transient and less than 1.5v for a 10% load transient. Response time is less than 25millisec for line transients and 150millisec max for load transients.

Voltage adjustment is accomplished by means of a pot. No tubes or variacs are incorporated in the unit. When short circuited, line current is automatically limited, protecting power supply from internal damage.

Magnetic Research Corp., Dept. ED, El Segundo, Calif.

CIRCLE 44 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Divider Has Zero Insertion Loss



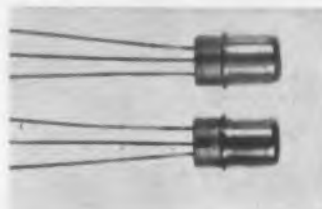
The new power divider, Model PD-90, splits microwave power without losses. It has zero insertion loss; the division of power is accomplished by means of matched transformers

rather than by dissipative networks. The power at each output is exactly half of that at the input (i.e. 3db) with a balance between outputs of 40db or better. Model PD-90 has type "N" female connectors at each arm. Five models cover the entire frequency range from 800Mc to 10,000Mc.

Empire Devices Products Corp., Dept. ED, 58-15 Bell Blvd., Bayside, N. Y.

CIRCLE 45 ON READER-SERVICE CARD FOR MORE INFORMATION

Medium Power Transistors Up to 300mw Audio Output



Types 2N223, 2N226, 2N224, are specifically designed for the audio stages of transistorized radios. In driver and Class B push-pull operation, these new, her-

metically sealed, p-n-p transistors provide up to 300mw audio output at battery supply voltages of 3 to 12v. Extremely linear d-c current amplification up to 100ma of collector current assures minimum distortion. Output transistors 2N226 and 2N224 can be made available in matched pairs.

Philco Corp., Dept. ED, 4700 Wissahickon Ave., Philadelphia 44, Pa.

CIRCLE 46 ON READER-SERVICE CARD FOR MORE INFORMATION

Ohmmeter

Measures Up To 5000 Million Megohms



This new Tera-Ohmmeter is designed for making resistance measurements up to 5000 million megohms (5000 tera-ohms). Designated Type FT-H4, it is sim-

ilar in most respects to the well-known Type FT-H except that it has 10 times the sensitivity. The FT-H4 includes a test voltage which is continuously variable from 100 to 1000v.

The instrument is of particular value in such applications as the development of special insulating materials or wherever it is desired to measure extremely wide ranges (20 megohms to 5000 million megohms) of resistance.

Specifications are: range—20 megohms to 5000 million megohms in 6 ranges; test voltage—continuously adjustable from 100 to 1000v d-c; accuracy— $\pm 3\%$ in scale center; test samples—grounded, ungrounded, or with guard ring electrode.

Instrument Div., Federal Telephone and Radio Co., Dept. ED, 100 Kingsland Rd., Clifton, N.J.

CIRCLE 47 ON READER-SERVICE CARD FOR MORE INFORMATION

High Voltage Leakage Tester Audibly Signals Defects



Used for the high voltage a-c breakdown testing of equipment when a maximum leakage current is specified, the Model 103 cancels current due to the electrostatic capacity

of the tested article and checks insulation leakage only.

Adjustable, the unit will cancel up to 0.005 μ fd capacity and has external binding posts for adding greater correction on the job. The leakage limit can be set between 0 and 5ma.

High leakage and grounds are signalled by a buzzer, and arcing above 20 μ amp by a speaker. Test voltages from 400 to 2100v a-c are provided by the unit, which has a momentary contact on-off switch, pilot light, voltmeter, and milliammeter.

Slaughter Co., Dept. ED, Young & College Sts., Piqua, Ohio.

CIRCLE 48 ON READER-SERVICE CARD FOR MORE INFORMATION

Delay Line

Taps Every 1.45 μ sec



This is a new lump constant delay line specifically developed for telemetering, digital or analog computers, pulse circuits, coders and decoders.

Characteristics include: 20.30 μ sec with end delays; taps every 1.45 μ sec; tap accuracy $\pm 0.1\mu$ sec; rise time better than 0.7 μ sec;

low attenuation, less than 4db overall; operating temperature range from -55° to 155° C; characteristic impedance 180 ohms for standard unit.

Epsco, Inc., Dept. ED, 588 Commonwealth Ave., Boston, Mass.

CIRCLE 49 ON READER-SERVICE CARD FOR MORE INFORMATION

Electrical Connectors

In 5 Assembly Styles

This is a new series of waterproof, shock-resistant electrical connectors with five assembly styles. The series, designated QWL, is being used with multi-conductor cable on ground-launching equipment for missiles and ground radar units. A complete line of accessories, including cable assembly with Kellems grip, and protection cap rings, provides adaptability of the series to any heavy-duty applications.

The various assembly styles provide either pin or socket contacts in receptacle or plug. Provisions also have been made for alternate positions, thermocouple contacts, and coaxial circuit contacts. Among the assembly styles are: wall-mounting receptacle (QWL3100); cable-connecting receptacle (QWL3101); box-mounting receptacle (QWL3102); straight plug (QWL3106); a flange-mounting plug (FLMTPLUG); and two types of jam nut receptacles.

Three styles of cable accessory clamps are available to accommodate various cable sizes. A straight style is designed for a cable with diameter near the size of the connector; step-down style is for conduit that is smaller than the diameter of the connector; and step-up style is for a large cable with smaller connectors.

Scintilla Div., Bendix Aviation Corp., Dept. ED, Sidney, N. Y.

CIRCLE 50 ON READER-SERVICE CARD

Subminiature Teflon Lead Wire

For Slip-Ring Assemblies

This miniature Teflon insulated solid wire designated "DQT," is available in sizes from 34 AWG to 20 AWG, in eight solid colors. Because of its reduced diameter, "DQT" is an excellent lead for slip-ring assemblies. The Teflon insulation is not affected by the high molding temperatures encountered during the fabrication of the slip-ring assembly.

Hitemp Wires, Inc., Dept. ED, Mineola, N. Y.

CIRCLE 51 ON READER-SERVICE CARD

CIRCLE 52 ON READER-SERVICE CARD

actual size

JFD GIVES YOU A NEW SUB-MINIATURE TRIMMER PISTON CAPACITOR SMALLER THAN THE ERASER OF YOUR PENCIL! 2 GRAMS OF COMPACT PRECISION... ONLY 5/16" IN LENGTH.

A Giant in Performance... Sub-Miniature in Size



PISTON CAPACITORS

FOR AUTOMATION AND PRINTED CIRCUIT APPLICATIONS

Over 1 year in development, it's here at last! The new precision sub-miniature JFD Variable Trimmer Piston Capacitor, designed expressly for use in automation and printed circuitry.

Features: Stability, approximately Zero temperature coefficient... End stops at either end of adjustment... working temperature - 55° to + 125°C... Anti-back lash and thread wear compensation.

These new JFD Capacitors are available in 2 models to meet your most exacting network applications:

MODEL	OVERALL LENGTH	CAPACITANCE
VC9G	9/16"	0.5 MMF. TO 8.5 MMF.
VC10G	5/16"	1 MMF. TO 4.5 MMF.



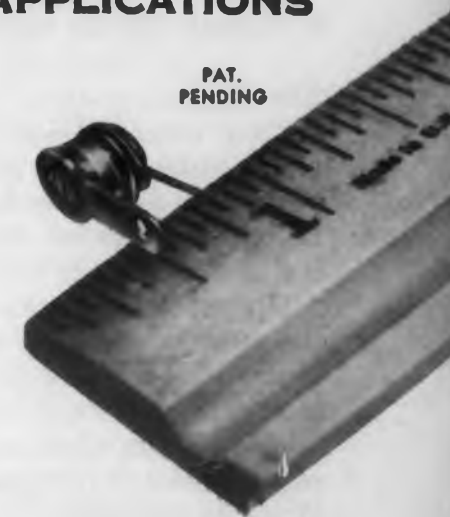
Both units feature glass dielectric and invar silver-plated rotors. Write today for Bulletin No. 106 which gives you complete electrical characteristics.

Whether you specify these new Piston Capacitors or any of the many other JFD units for your critical tuning requirements, you upgrade efficiency and stability of performance. A letter will bring you complete details. Write today.



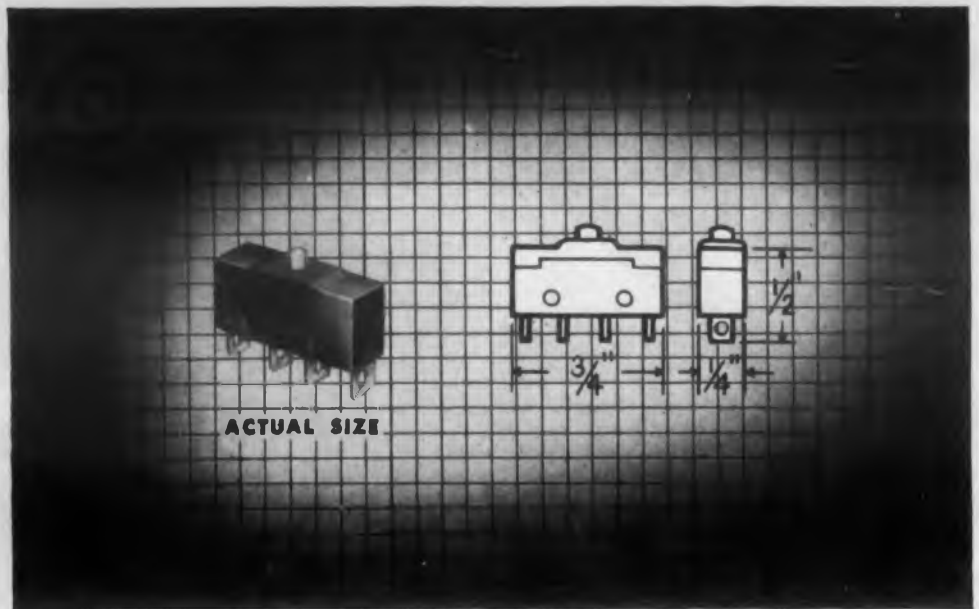
GO FORWARD WITH JFD ENGINEERING!

JFD MANUFACTURING CO., INC. 6101 16TH AVENUE, BROOKLYN 4, N. Y.



HIGH CAPACITY

in very small size!



NEW Acro Subminiature Snap-Switch

- **HIGH ELECTRICAL RATING**—10 Amps at 115 volts or 230 volts A.C. or 28 volts D.C.
- **EXTREME TEMPERATURE RANGE**—from +350°F to -100°F
- **LONG MECHANICAL LIFE**—many millions of cycles, continuous duty
- **DOUBLE CIRCUIT TERMINAL ARRANGEMENT**

The big feature about this little switch is its high rating. It has *four times* the capacity of most switches in this size. And temperature extremes pose no problem. The Acro subminiature switch will operate within a range of from +350° to -100°F. Long life is assured through use of the rugged Acro rolling spring principle, up to 10 million cycles continuous duty.

High rated Acro subminiature switches are your answer to the problem of controlling big loads in confined areas. And on lesser loads their excess current-carrying capacity is a good safety factor. Four terminal construction permits wiring double circuits where required. The entire unit is housed in a plastic case and can be adapted to any present type actuator. Write for literature.

ACRO

MANUFACTURING COMPANY

SWITCH DIVISION

Columbus 16, Ohio

Plants at Columbus and Hillsboro

REPRESENTATIVES IN PRINCIPAL CITIES

CIRCLE 54 ON READER-SERVICE CARD FOR MORE INFORMATION

Batteries

Use New Grid Alloys



New grid alloys and other product improvements have been introduced in this line of batteries for stationary power applications. They are expected to extend service life up to 10% and reduce maintenance requirements.

The improvements have been made in the flat-plate battery line intended specifically for uses in the electric utility field, signaling, telephone service, emergency lighting and other industrial operations. The line for the first time includes Silvium positive grids. Silvium, an alloy of lead, silver and other metals, has superior ability to resist corrosion and withstand overcharging.

The improved design provides greater space between the plates and the top and the bottom of the jar, substantially increasing electrolyte volume. The greater volume of electrolyte increases the high discharge capacity of the cell, providing an extra reserve of power when needed.

In addition to the wide application in float services, the improved Exide-Tytext battery also is well adapted to cycle services. The enlarged reservoir at the bottom of the jar provides ample sediment space for even the most severe cycle applications.

Exide Industrial Div., The Electric Storage Battery Co., Dept. ED, Box 8109, Philadelphia 1, Pa.

CIRCLE 55 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Waveguide Horns

From 8.2 Through 75.0kMc



This is a complete series of precision standard horns for use in antenna design and measurement in the range from 8.2 through 75.0kMc.

Nominal gain of the RG-52/U X-band model MA-647 is 15db. In the 50.0-75.0 kMc millimeter range, gain of standard horn model MA-627 is 25db.

The horns are fabricated from brass sheet stock which is silver-plated. External finish is blue-gray baked enamel. Maximum VSWR over a specified waveguide size is 1.10.

Microwave Associates, Inc., Dept. ED, 22 Cummington St., Boston, Mass.

CIRCLE 56 ON READER-SERVICE CARD FOR MORE INFORMATION

HYCOR

Miniature

MAGNETIC CLUTCHES



Only 1 watt of power required...

to develop 15 oz. in. of torque with a response time of 5 milliseconds. Only two moving parts which eliminate all maintenance problems.

Minimum dimensions (only 1" o.d.) facilitate their use in compact assemblies. Extremely low cost enables designers to utilize the benefits of multiple clutching in inexpensive electronic equipment.

Send for
Bulletin C-1
for complete details

Hycor's systems engineers will be pleased to assist in special design applications.

Representatives in principal cities

HYCOR

DIVISION OF INTERNATIONAL RESISTANCE COMPANY
12970 Bradley Avenue, Sylmar 4, Calif.

CIRCLE 57 ON READER-SERVICE CARD

SHOCK and VIBRATION MOUNTS

for shipboard and vehicular service



New, useful data

This new, 8 page, Barry Product Bulletin tells you all about the mounts whose outstanding performance has won their acceptance as a standard for U. S. Naval applications.

In Combat Service

Barry Cup-Mounts protect sensitive electronic and electrical equipment and machinery from the high-impact shocks of Naval combat service. Vehicular equipment on Barry Cup-Mounts is protected from the impact of gunfire recoil, projectile shock and impact, and travel over rough terrain. These mounts are particularly designed for equipment that must meet MIL-T-17113.

In Industrial Service

Barry Cup-Mounts are widely used to protect vehicular and railway electronic and electrical equipment. As shipping-and-service isolators built into the equipment, they give the advantages of simplicity and economy.

Free Bulletin

Barry Product Bulletin #56-02 gives you detailed data on the characteristics and use of Cup-Mounts. Write today for your free copy.

Barry's New Western Division in Burbank, California will offer engineering, prototype, and short-run "specials" production.

BARRY B MOUNT

BARRY CONTROLS

INCORPORATED

SALES REPRESENTATIVES IN ALL PRINCIPAL CITIES

775 PLEASANT ST., WATERTOWN 72, MASS.

CIRCLE 58 ON READER-SERVICE CARD

Delay Lines

In Matched Multiple Units

This is a new series of very long delay lines in matched multiple units. The assembly shown comprises three 20Mc, 2780 μ sec lines matched within 0.25 μ sec of one another. Spurious responses are 45db or more below the main delayed signal.



These lines can be supplied in dual or triple assembly, with or without temperature control. At the present time, matching of delays can be specified as close as 0.25 μ sec.

Andersen Laboratories, Dept. ED, W. Hartford, Conn.

CIRCLE 59 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Switch

Samples Up To 10 Signal Sources



The Beamplexer, a fast electronic switch used to sample up to 10 separate signal sources and put them out in sequence on a

single line, has been thoroughly re-designed to meet testing requirements found in the field.


One of the most important applications of the new Beamplexer is as an accessory to the conventional single channel oscilloscope. It provides the user with the advantages of multi-channel oscillography at a fraction of the cost of a multi-channel scope.

Individual position and amplitude controls for each of the 10 input channels allow vertical positioning of all the signals on the face of the oscilloscope so that they may be superimposed or placed in any desired relationship.

Each of the Beamplexer's input channels is ac coupled to an individual triode amplifier which has gain control and a pedestal level control in its grid circuit. The cathode of each of the triode amplifiers is connected to a corresponding target of a beam switching tube. As the beam steps through its 10 positions, at adjustable speeds ranging from push-button to 100kc, current is supplied to the tube connected to the particular target on which the beam is formed. In this way only one tube at a time is allowed to conduct through the output circuit.

Burroughs Corp., Dept. ED, Detroit, Mich.

CIRCLE 60 ON READER-SERVICE CARD FOR MORE INFORMATION



Are You an Engineer Who is lost in the Mob?

Has a year or two of your present job made it obvious that you're just one of the mob and the odds on your being seen—let alone given some challenging assignment—are pretty sad?

We're offering challenging careers—not jobs—that can be just as exciting and rewarding as your initiative makes them . . . Career opportunities in circuitry, applications, development, equipment design, electron tube and transistor development and production.

Submit resume or address request for personal interview to D. Bellat, Personnel Director, Tung-Sol Electric Inc., 200 Bloomfield Avenue, Bloomfield, N. J.

 **TUNG-SOL**[®]

EAST ORANGE • BLOOMFIELD, N. J.



Radio and
TV Tubes



Aluminized
Picture Tubes



Special Purpose
Tubes



Semiconductors



Color
Picture Tubes

CIRCLE 61 ON READER-SERVICE CARD FOR MORE INFORMATION



REVERE

Permacode

TEFLON-INSULATED WIRE

Striped to the core

PERMACODE is a Teflon-insulated hook-up wire with striping that goes right down to the conductor . . . with colors that won't rub off . . . that heat won't change . . . that are good for the life of the wire. Coding is available in a wide variety of combinations of twin, triple or quadruple stripes selected from fifteen basic solid colors. Insulation quality unaffected by striping process.

Revere PERMACODE — with tough extruded Teflon insulation — offers excellent abrasion resistance and high dielectric characteristics for continuous operation from -90°C to $+210^{\circ}\text{C}$. Strips clean. Doesn't shrink when soldered. Isn't hurt by the slip of a hot soldering iron.

PERMACODE hook-up wire is available with either solid or stranded silverplated copper conductors. Shielding and jacketing can be furnished. Sizes 28 to 16 gauge in 0.010" wall (600 volt) and 0.015" wall (1,000 volt) thicknesses. Conforms to MIL-W-16878, Types E and EE.

®Revere trade name

*E.I. du Pont trademark

TYPICAL SPECIFICATIONS — 22 Gauge Permacode Wire

Spark Test Voltage	3000 volts
Insulation Resistance	Greater than 10^4 megohm/1000 ft.
Continuous Operating Range	-90°C to $+210^{\circ}\text{C}$ †
Flammability	Does not support combustion
Operating Voltage	600 or 1000 volts
Tensile Strength	2000-3000 PSI
Shrinkage	Less than $\frac{1}{8}$ " in 18" at 250°C
Abrasion (Per MIL-T-5438)	Passes 30" of 400 grit, aluminum oxide, $\frac{1}{2}$ lb. weight
Water Absorption	0.0%
Specific Gravity	2.2 average
Chemical and Solvent Resistance	Excellent

†Wire passes 96 hour, 250°C heat ageing test as required by MIL-W-16878.

Write today for Engineering Bulletin No. 1901 describing Revere PERMACODE wires.



Revere CORPORATION OF AMERICA



WALLINGFORD, CONNECTICUT A Subsidiary of Neptune Meter Company
CIRCLE 62 ON READER-SERVICE CARD FOR MORE INFORMATION

Channel Termination Unit

Carried From Station to Station



The new Model SC-1 service channel termination unit is designed to provide full talking and signaling facilities on the baseband of the company's CLR-6 or CLR-7 microwave terminal and repeater equipments.

The 2 lb unit may be carried from station to station by service personnel, thus assuring continuous contact with the system control point. The unit plugs directly into the front panel jacks of the CLR equipment and provides a means of monitoring and inserting voice frequencies into the baseband of the system at a response of 200 to 2000cy. It may also be operated over a standard derived telephone channel.

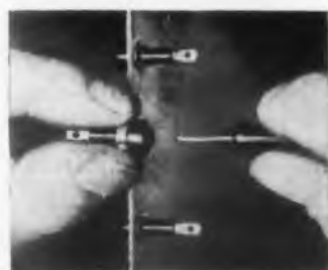
The unit includes an a-c power cord which connects directly to the utility outlet on the CLR-6 or CLR-7 rack. Three type L-5021 transistors and a miniature loudspeaker are used for transmission and reception. Front panel switches are provided for "transmit-receive" selection and for outbound signaling, accomplished by a built-in audio tone oscillator.

Philco Corp., Dept. ED, Govt. & Industrial Div.
4700 Wissahickon Ave., Philadelphia 44, Pa.

CIRCLE 63 ON READER-SERVICE CARD FOR MORE INFORMATION

Test Jack Eyelets

For Fast Assembly



This is a new, insulated miniature test jack with an integral molded eyelet for fast, secure mounting. Known as the "Stak-in" Mini-Test Jack No. 110BCI, it was designed specifically to

provide points of check for circuitry on equipment front panel, chassis, or other accessible check points.

To insure positive contact and long life over thousands of insertions, the jack incorporates a 360° wrap-around beryllium copper clip, silver plated for 60 hours salt spray. To speed soldering, the terminal end is hot-tin dipped, and a large wire hole is provided. Contact insulation is nylon rated for 3.5kv d-c with the jack mounted on metal panel, test prod inserted. Ambient temperature range is from -30°C to 105°C. The integrally molded eyelet is cadmium plated, brass.

Alden Products Co., Dept. ED, Brockton, Mass.

CIRCLE 64 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW

LINK 201 PHASE COMPARATOR

Gives Precision
Readings To Fractional
Milliradians



To computer engineers, the Link Phase Comparator offers an accurate, functional unit for measuring quadrature voltages. Phase shifts in reference and circuit transformers are readily determined.

Now it's easy to obtain precision measurement of phase relationships of in-phase and out-of-phase voltages. Achieve accuracy of 1/10 to 1/3 milliradian within the 60-400 cycle range.

DESIGN FEATURES:

- Null-type adjustment with fine vernier control
- Fast hook-up binding posts for wide variety of terminal attachments and wires
- Functionally grouped controls for ease of operation
- Compact and light weight (dimensions: 10" x 12 3/4" x 13 3/4"; weight: 22 pounds)

Learn how the new Link 201 can help you. Write today to Dept. ED for complete information.

LINK AVIATION, INC.

A SUBSIDIARY
OF GENERAL
PRECISION
EQUIPMENT
CORPORATION

BINGHAMTON,
NEW YORK



CIRCLE 65 ON READER-SERVICE CARD

Solder

Activated Rosin-Flux

A highly activated rosin-flux that will remove tough surface oxides from most common metals, and is both non-corrosive and non-conductive, is contained in the new purified metal solder.

Designed for soldering applications where chemical surface cleaning is normally difficult, the flux spreads fast to remove oxides and inhibit re-oxidation prior to solder flow. These qualities assure production line soldering of copper, brass, nickel-plate, cadmium-plate, German silver and other metals that previously required a corrosive acid flux.

The activated flux does not throw off objectionable odors or fumes, nor will it boil away or char under excessive heat. Residues can be left on the joints without damage, but can also be easily removed if desired.

The bright, porous-free joints have withstood prolonged humidity-temperature tests at 98°F and 95% relative humidity for 72 consecutive hours under rigid test conditions without any sign of joint breakdown, corrosion or changes in original solder properties.

Anchor Metal Co., Dept. ED, 244 Boerum St., Brooklyn 6, N. Y.

CIRCLE 66 ON READER-SERVICE CARD

Aluminum Foil Wire Markers Are Self-Sticking

This new self-sticking aluminum foil metal wire marker features high resistance to oils and solvents. It is only 3 mils thin, conforms to wires without bulking, and withstands constant operating temperatures up to 375°F.

The legend is imbedded in full soft aluminum for lasting, positive wire identification. The markers can't curl or slip off oily wires and temperature does not discolor it.

Furnished on handy Blue Streak dispenser cards for quick application, the markers are coated with a silicone plastic overcoating to protect against abrasion—shed grease, water, dirt.

W. H. Brady Co., Dept. ED, 727 W. Glendale Ave., Milwaukee 9, Wis.

CIRCLE 67 ON READER-SERVICE CARD

CIRCLE 68 ON READER-SERVICE CARD ➤

DU PONT

ELECTRONIC DESIGN NEWS

PROPERTY AND APPLICATION DATA
ON THESE VERSATILE ENGINEERING MATERIALS:
"ZYTEL," "ALATHON," "TEFLON," "LUCITE."

Mechanical properties and high dielectric strength of TEFLON® unaffected by extremes of temperature

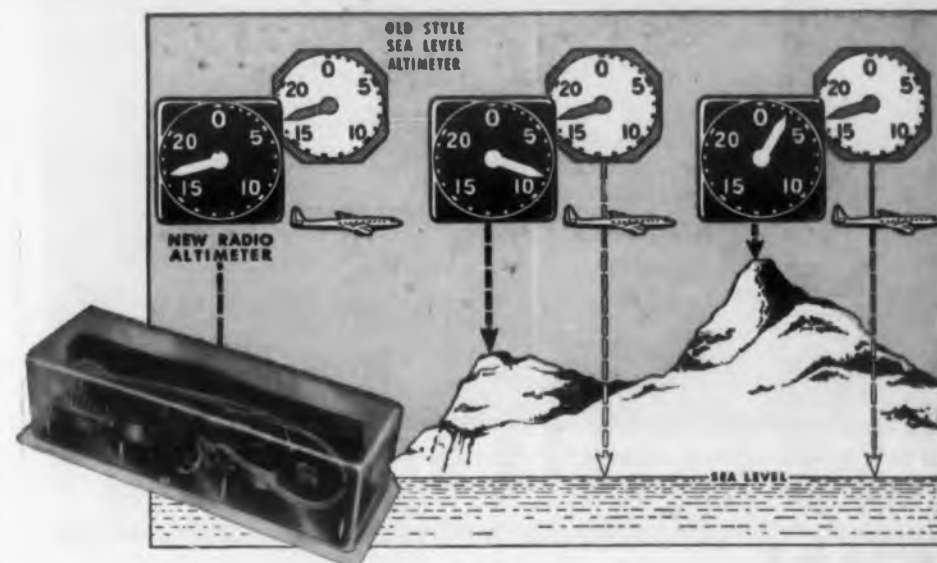
Electrical properties of TEFLON® constant over tested range of 60 cycles to 10¹⁵ cycles

The unique combination of properties of TEFLON offer many advantages to the electronics industry, permitting improved design and providing unexcelled performance. TEFLON is capable of continuous service at 260° C., exceeding the requirements of Class H materials.

The power factor of TEFLON is less than 0.0003 over the measured spectrum (60 cycles to 10⁸ cycles), and its dielectric constant is 2.0 over the same range. Following prolonged soaking in water, the volume resistivity of TEFLON is greater than 10¹⁵ ohm-cm., and water absorption (ASTM D570-42) is only 0.005%. TEFLON has good arc resistance and its short-time dielectric strengths are high, ranging from 1,000 to 2,000 volts per mil depending upon thickness.

SEND FOR MORE INFORMATION

For complete details that will help you further evaluate DuPont TEFLON for use in your product-development programs, mail the coupon at the right.



TEFLON tetrafluoroethylene resin is used as cable insulation in this new radar altimeter. One of these cables carries microwave energy from the magnetron oscillator tube to the an-

tenna. The other cable provides interconnection within the transmitter-receiver unit. (Cable used in this altimeter is manufactured by Surprenant Mfg. Co., Clinton, Massachusetts.)

A new radar altimeter, made by the Raytheon Manufacturing Company, Waltham, Massachusetts, furnishes continuous terrain-clearance information and flashes a warning light when a preset minimum is reached. Du Pont TEFLON was selected as the insulation for cabling in this altimeter because of its ability to perform under the wide range of temperatures encountered in the aviation field.

TEFLON tetrafluoroethylene resin is used in electronics equipment as

molded components, tape, and extruded insulation. The excellent dielectric properties of TEFLON, even at ultrahigh frequencies, and its moisture resistance are particularly important in the electronics field. Heat resistance is frequently essential, too, especially with the present trend to miniaturization of electronics equipment, which results in increased operating temperatures.

To evaluate Du Pont TEFLON for your own use, get property and application data by mailing coupon.

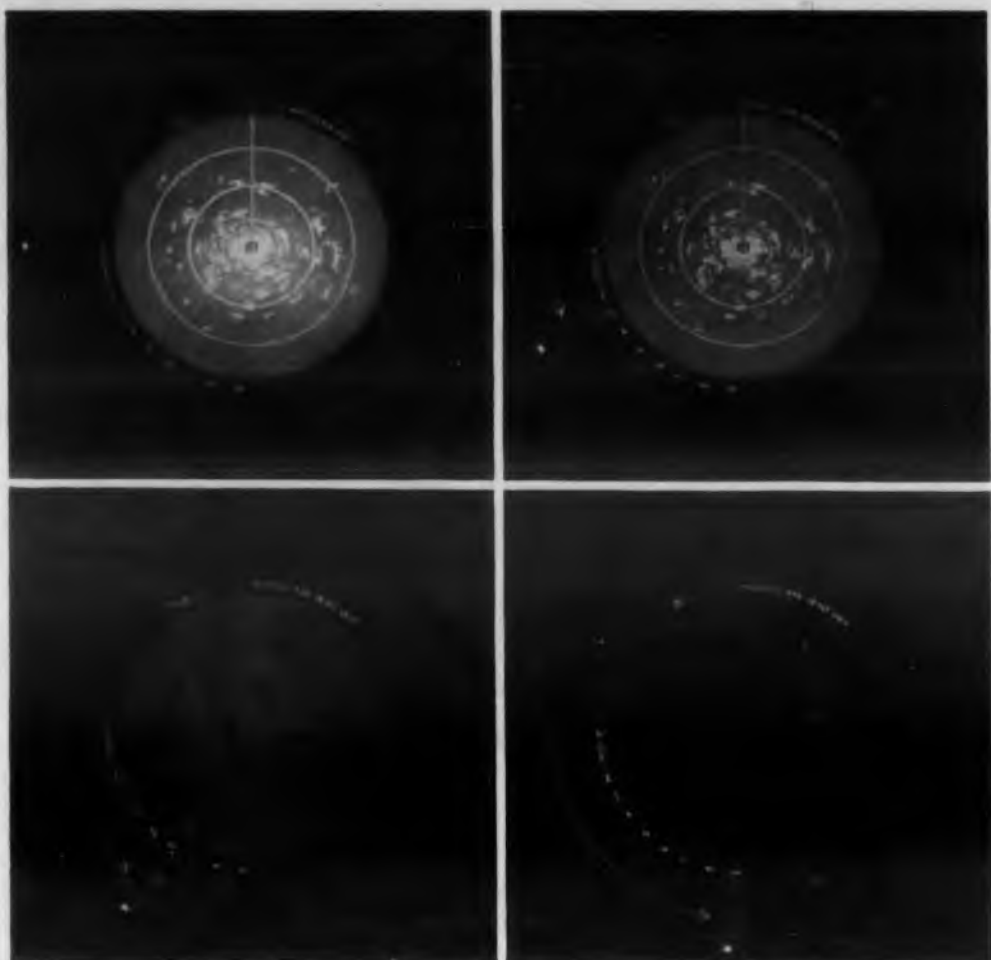
E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department
Room 417 Du Pont Building, Wilmington 98, Delaware.

In Canada: Du Pont Company of Canada Limited, P.O. Box 660, Montreal, Quebec

Please send me complete property and application data on Du Pont TEFLON.

I am interested in evaluating this material for

Name _____
Firm Name _____
Position _____
Type of Business _____
Street Address _____
City _____ State _____



HOW THE VARIABLE DENSITY FILTER WORKS—New Polaroid variable density filter enables radarscope operator to control brightness without re-focusing. When control knob is at "9 o'clock" (upper left), image is at full brightness. At "6 o'clock" (lower right), image is virtually blacked out.

NEW POLAROID[®] radar filter. . .

MECHANICALLY CONTROLS BRIGHTNESS . . . KILLS REFLECTIONS

The new Polaroid CP* Variable Density Filter for radar (and all instruments using cathode ray tubes) improves readability two important ways. First, it enables the operator to control brightness mechanically — *without* re-focusing. Second, it swallows up reflections and provides a glare-free, easy-to-read image regardless of surrounding light.

Polaroid has developed a whole new family of polarizing filters like this one, designed to solve many of the engineer's most stubborn visibility problems. Wherever your scope design calls for filters . . . to eliminate reflections, increase contrast, even change the color of the image . . . or for any combination of these effects, we'd like to show you how Polaroid Filters can help.

Write or phone John Mulhall, Cambridge (UNiversity 4-6000) for more information.

*Ask for this new folder describing Polaroid CP (Circularly Polarizing) variable density and variable color filters.



POLAROID CORPORATION

Cambridge 39, Massachusetts

CIRCLE 70 ON READER-SERVICE CARD FOR MORE INFORMATION

Tachometer

Features a Plug-In Assembly



Model ETC features a package type plug-in assembly that permits the replacement of any or all of 9 separate electronic components in only a few minutes. Since the

tachometer's circuitry permits self-checking for correct operation and accuracy, it is merely necessary to replace individual packaged components until the unit is again in operation.

This feature alone makes Model ETC valuable for two reasons. First, when the equipment is in daily use, its down time due to failure is held to a minimum. And, second, the services of a skilled electronics engineer are not necessary to service the unit.

In operation, Model ETC counts rpm, rate, or frequency by counting electrical pulses for an accurately timed interval. The count is displayed directly on glow counter tubes and is accurate to ± 1 count. To count rpm, a 60 tooth gear on the transducer or generator is used. Model ETC reports pulses from 10 to 50,000/sec.

The unit can be operated from any photoelectric, magnetic, electrical or electromechanical means that produces pulses of from 0.2v to 115v.

The Standard Electric Time Co., Dept. ED, Springfield, Mass.

CIRCLE 71 ON READER-SERVICE CARD FOR MORE INFORMATION

Distortion Meter

Measures From 1 To 100Mc



The Model 85B has been modified to permit its use either as a distortion meter or as a sensitive broadband r-f voltmeter. The unit is capable of measuring total

distortion of an r-f source from 1 to 100Mc.

Used with a 50-ohm or a high-impedance probe, the voltmeter section has a range of 0.001 to 3v from 0.2 to 400Mc. As an ultrasensitive watt-meter, the device gives readings down to 0.02 μ w.

Boonton Electronics Corp., Dept. ED, 738 Speedwell Ave., Morris Plains, N. J.

CIRCLE 72 ON READER-SERVICE CARD FOR MORE INFORMATION

SOUND ADVICE!

New Isophon ELECTROSTATIC TWEETERS

*Easily included
in your present circuits!*

- ★ Better performance in higher frequencies (7000-20000 cycles)
- ★ Compact, space-saving
- ★ Substantially lower cost
- ★ Remarkable brilliancy of sound



Write for details
and spec. sheet D-7

Arnhold ARNHOLD
CERAMICS, INC.

CIRCLE 73 ON READER-SERVICE CARD

Designed for Dependability in Transistor Circuits



NEW MALLORY MERCURY BATTERIES

Unique snap-together cell design† brings new economy to Mallory Mercury Batteries—provides long life and constant discharge features at operating costs even lower than ordinary batteries. Triples usual life expectancy in transistor radios. Miniature 15, 22.5 and 45 volt batteries now available as well as special voltages and configurations.

MALLORY SUBMINIATURE CAPACITORS

Newly developed Type TNT tantalum capacitors . . . another Mallory "first" . . . offer ratings never before possible in a case only 0.145" in diameter by 3/8" long. Five different values: 80 mfd. at 3 volts; 50 mfd. at 6 volts; 25 mfd. at 15 volts; 15 mfd. at 30 volts; and 8 mfd. at 50 volts.

For technical facts, write to

P. R. MALLORY & CO. INC.
Indianapolis 6, Indiana

†Patent applied for

P. R. MALLORY & CO. INC.
MALLORY

CIRCLE 74 ON READER-SERVICE CARD

Rotary Actuators

Ultimate Static Load 600 Lb



This is a new 1 lb linear actuator designated R-5140 series. The unit includes radio noise filter, limit switches externally adjustable throughout entire stroke range, positive stops, optional thermal protection, and anti-rotation device.

Speed at max oper load of 150 lb is 12 in/min. Ultimate static load is 600 lb. The unit measures 2-5/8" x 1-3/16" x 4.0" (plus stroke length up to 8" and overtravel).

Airborne Accessories Corp., Dept. ED, 1414 Chestnut Ave., Hillside 5, N. J.

CIRCLE 75 ON READER-SERVICE CARD FOR MORE INFORMATION

Portable Transports

For Magnetic Tape Data Recording



Two new transports have been developed for accurate magnetic tape data recording under adverse environmental conditions. Each serves as a complete mobile tape recording system with provisions for up to 26 or more data channels, depending on system characteristics.

The Model 541 transport is particularly useful where large quantities of data are to be recorded at one time. Its 10-1/2" reels carry 2400 feet of 1-1/2-mil base tape, 3600 feet of 1-mil base tape. For moderate recording times, the Model 581 is the more desirable. Equipped with 7-1/4" reels, it carries 1200 feet of 1-1/2-mil base tape, 1800 feet of 1-mil base tape.

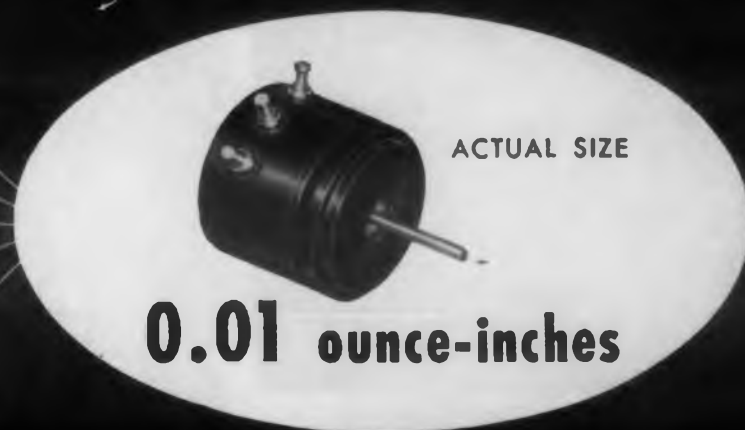
While standard models of the two transports require only d-c power for operation, a 400cy capstan motor can be supplied. Any single capstan speed from 30 to 1/2ips is available, and interchangeable capstan assemblies permit operation at more than one speed.

The new transport can be successfully operated at temperatures from -55 to +55 C, up to 95% humidity, and under conditions of extreme vibration and shock.

Davies Labs., Inc., Dept. ED, 4705 Queensbury Rd., Riverdale, Md.

CIRCLE 76 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW Jewel-bearing "LO-TORK"



ACTUAL SIZE

0.01 ounce-inches

PRECISION wire-wound POTENTIOMETER

Jewel bearings for lowest torque, and superior seal against surroundings that contain abrasive dust, make this new, Model LLT 7/8 Waters pot the ideal unit for high-reliability service where minimum torque is essential. With torque low enough to permit actuation by a Bourdon tube or a bimetallic thermal element, this potentiometer offers new advantages in sensitive-instrument applications as well as in computer, servo, and selsyn uses. Check your needs with these specifications:

Maximum torque:0.01 ounce-inch
Dissipation:one watt at 80° Centigrade
Resistances:100 ohms to 100,000 ohms
Weight:1/2 ounce
Outside diameter: 0.885 inch Body depth: 7/8 inch
Linearity: 0.5% standard; on special order, 0.25%
Winding angle: 354° standard; on special order, 360°
Ganging: to six decks with no increase in diameter.

Where the features of a ball-bearing potentiometer are desirable, specify Waters Model LT 7/8 "Lo-Tork" potentiometer.

Write for data sheets on jewel-bearing and ball-bearing precision wire-wound potentiometers.

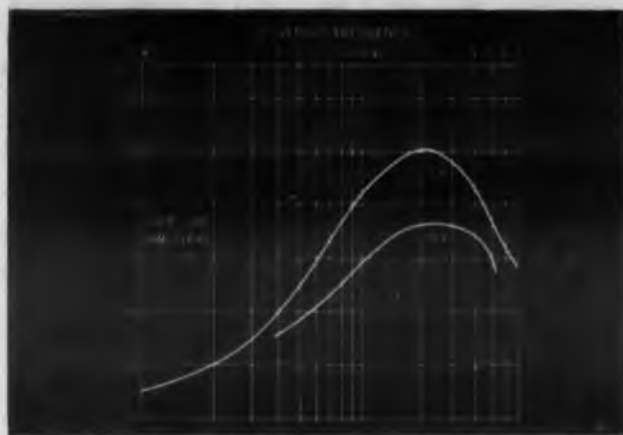
Do you ever need pots that are "just a bit different"? Maybe we can help you — by modifying a standard Waters design or by taking a bold, new approach. Tell us your need and we'll tell you what we can do.

WATERS MANUFACTURING, inc.
Wayland, Massachusetts
Mail address P.O. Box 368 So. Sudbury, Mass.
APPLICATION ENGINEERING OFFICES IN PRINCIPAL CITIES



CIRCLE 77 ON READER-SERVICE CARD FOR MORE INFORMATION

variable "L" by BURNELL



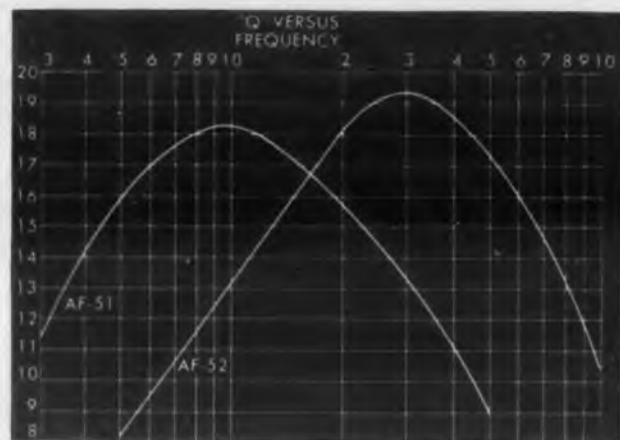
Typical Q vs. frequency characteristics of Adjustoroids.

RANGE OF NORMAL INDUCTANCES FOR STOCK ADJUSTORIODS

IND. MHY	AT-11	AT-12	AT-0	AT-6	AT-10	AT-4	AT-1	AT-15	AT-2
50									
300		500							
750					750				
1000									
2M									
3M			3M						
5M	5M								
10M									
15M						15M	15M		
50M									
80M									
100M									
125M									125M

For nominal D. C. R. values refer to Burnell catalog No. 103.

COMPLETE TECHNICAL INFORMATION UPON REQUEST
© copyrighted, select wanted for.



Typical Q vs. frequency characteristics of Variable Inductors.

ADJUSTORIODS[®]

The Adjustoroid, a low cost adjustable toroid, exclusively developed by Burnell & Company, Inc., contains an actual complete toroid with all the excellent characteristics of the non-adjustable types. Adjustment is obtained by a completely stepless function with magnetic biasing.

The nominal inductance value for an Adjustoroid is the maximum value, and the inductance range is the nominal value minus approximately 10%.

Hermetically sealed to meet Government MIL specifications. Many types of networks in tuned circuits are being produced which employ the Adjustoroid in completely hermetically sealed packages.

Intermediate inductance values as well as special taps and extra windings available on special order with minimum delay.

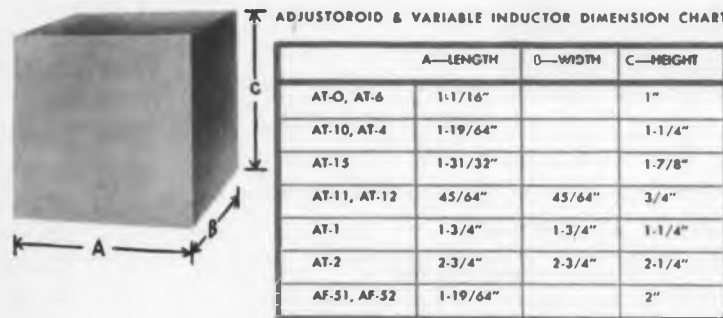
For additional technical data on Adjustoroids, refer to equivalent toroid in catalog.



AT-0, AT-6, AT-10, AT-4



AT-1, AT-2, AT-11, AT-12



and now ...

VARIABLE INDUCTORS

AF-51 AF-52

(20-500 cycles)

Maximum Q at 100 cycles

(50-1000 cycles)

Maximum Q at 250 cycles

Burnell Variable Inductors have the similar characteristics to the Adjustoroid except they are especially designed for low frequency applications or for conditions where high inductance values are required. Variable Inductors are available in all inductance values up to 1000 Hys.

PACIFIC DIVISION

BURNELL and CO., Inc.

720 Mission Street, South Pasadena, California



CIRCLE 78 ON READER-SERVICE CARD FOR MORE INFORMATION

Airborne Power Supply

Efficient Up to 60,000 Ft

This new dual-magnetic-regulated airborne power source features efficient performance at altitudes up to 60,000 feet, improved output adjustment and versatile mounting.



The unit, designated the Stabvolt MRP-5-1S, provides a transient-free 5v d-c source for missile and aircraft instrumentation. High-altitude efficiency is accomplished through use of a 2306-55 Cannon connector, which permits the MRP-5-1S to carry 115v a-c at 60,000 feet. A 25-turn Bourns Trimpot provides 0.5v output adjustment. Spot-welded mounting flanges permit mounting in any position, and allow for the severe shock and vibration encountered in missile applications.

Magnetic flux oscillator circuitry effectively isolates line voltage transients from the output and regulates d-c to 0.1% accuracy. Current capacity is 1 amp. The unit is short-circuit proof, has no tubes and requires no batteries or fusing. It is hermetically sealed with all components cast in thermosetting plastic, and meets MIL-T-27 and MIL-E-5272-A specifications. High-temperature silicon diodes assure stable operation at 100°C.

Magnetic Research Corp., Dept. ED, El Segundo, Calif.

CIRCLE 79 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Counter

Measures Frequency, Period and Time



This is a new multi-purpose electronic counter measuring frequency 10cy to 1.1Mc, period 0.00001cy to 10kc, and time interval 3μsec to 27.8 hours.

The counter, Model 523B, presents direct reading results in seconds, milliseconds, microseconds, or kilo-

cycles. Accuracy of frequency measurement is ± 1 count \pm crystal stability of 2ppm/week.

A special pulse output permits Z-axis modulation of an oscilloscope to visually observe time interval start and stop on an input waveform, shown in the figure as bright spots on the input signal.

Hewlett-Packard Co., Dept. ED, 275 Page Mill Rd., Palo Alto, Calif.

CIRCLE 80 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • July 15, 1956

Optical Filters For Radarscopes



This new light-filter kills reflections on a radar-scope, or any cathode-ray tube instrument. The filter traps between 98 and 99% of all reflections

from surrounding windows and lights. By removing these reflections, which tend to wash out the display, it makes the image sharp and easy to read. It eliminates the need for bulky hoods or other light-shielding.

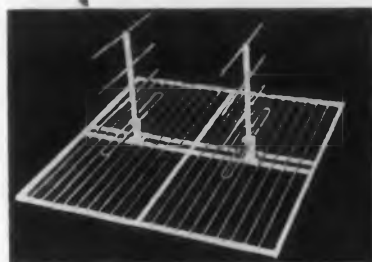
The filter gets its "one-way" properties through circular-polarization of the light striking it from outside sources. Lightweight and sturdy, it can be laminated in either glass or plastic, for easy mounting on any size scope.

Polaroid Corp., Dept. ED, Cambridge 39, Mass.

CIRCLE 81 ON READER-SERVICE CARD FOR MORE INFORMATION

Communications Antenna

Withstands Adverse Weather Conditions



This new series of communications-type antennas is designed to withstand the most adverse weather conditions while providing maximum gain. Series SY-41 antennas

are yagis with screen reflectors designed to operate in the region of 132 to 174Mc and 160 to 174Mc.

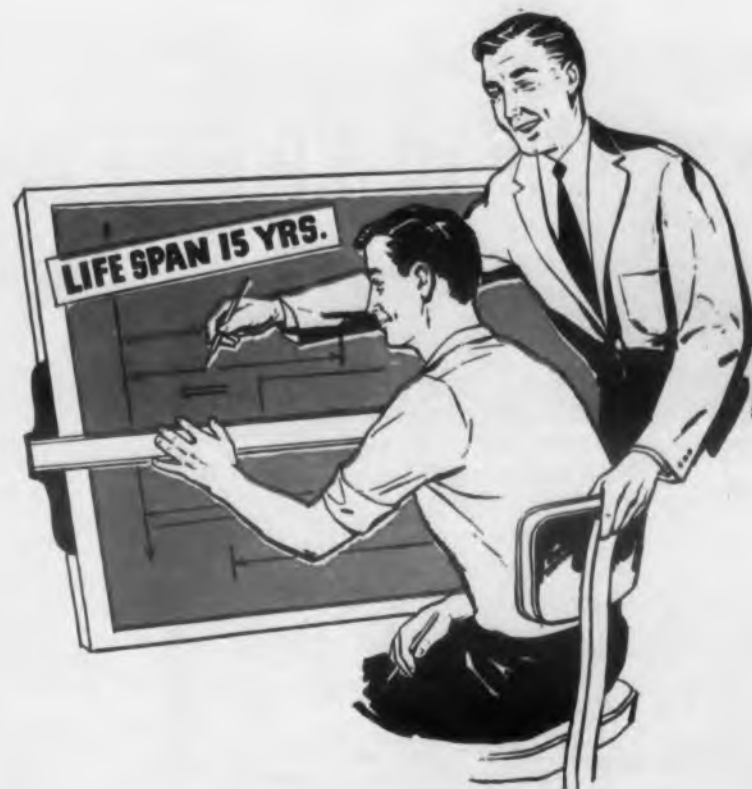
The antenna is a 4-element yagi with a folded-dipole driven element. With the addition of the screen reflector, the antenna shows a gain of 15.7db over an isotropic source. VSWR is under 1.25 for a single bay. Models are available with either a single or double antenna mounted on the single screen reflector.

An unusual mounting technique is employed whereby the antenna may be mounted on the side of the supporting tower, permitting orientation in any direction. The Series SY-41 may be polarized either vertically or horizontally thus permitting greater isolation between two antennas mounted adjacent to each other.

The all-aluminum antenna is completely welded in a single, rugged assembly. The completed assembly, including the screen reflector, is designed to withstand wind loads up to 250mph, and 175mph with an ice load of 1/2".

Technical Appliance Corp., Dept. ED., Sherburne, N. Y.

CIRCLE 82 ON READER-SERVICE CARD FOR MORE INFORMATION



El-Menco DUR-MICA Capacitors will match your equipment's life expectancy to at least 15 years!

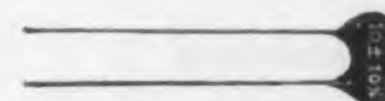
A recent series of the toughest trials has proved El-Menco DM15, DM20 and DM30 Dur-Mica Capacitors outlast all others. Accelerated conditions of 1 1/2 times rated voltage at ambient temperature of 125° centigrade found El-Menco capacitors still going strong after 10,000 hours. Similar conditions obtaining under normal usage would equal a lifetime of over 15 years!

Tougher phenolic casing means longer life, greater stability, over wide temperature range.

Meet all humidity, temperature, and electrical requirements of both civilian and MIL-C-5 specs.

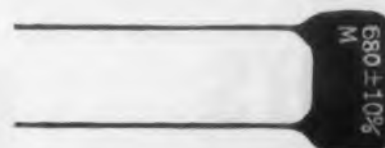
Parallel leads simplify use in television, electronic brains, miniature printed circuits, computers, guided missiles, and other civilian and military applications.

DM15



Actual Size

DM20



El-Menco Dur-Mica DM15, DM20, and DM30 Capacitors Assure:

1. LONGER LIFE
2. POTENT POWER
3. SMALLER SIZE
4. EXCELLENT STABILITY-SILVERED MICA
5. PEAK PERFORMANCE

Tell us your specific needs. Write for FREE samples and catalog on your firm's letterhead.



Take Your Own Word For It. Test El-Menco Dur-Mica Capacitors Yourself.



THE ELECTRO-MOTIVE MFG. CO., INC.
WILLIMANTIC, CONNECTICUT

- molded mica • mica trimmer
- tubular paper • ceramic

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Exclusive Supplier to Jobbers and Distributors in United States and Canada.

CIRCLE 83 ON READER-SERVICE CARD FOR MORE INFORMATION

PHAOSTRON



NEW 3½"
Rectangular
Meter

Now!...Phaostron
custom panel
meters are
available in

colors

at no additional cost

Time-tested and proven movements, anti-magnetic shielding, insulated zero adjustments and fine accuracy are familiar features of *Phaostron Custom Panel Meters*... now, something new has been added...

COLOR-CUSTOMIZED PANELS

Handsome harmonizing colors that will give a touch of distinction to your equipment. Send us a color swatch and we will make Phaostron color-customized panels to match... and at no extra cost!

Phaostron Custom Panel Meters, nine types in 77 Standard Ranges are available at your Parts Distributor. For special requirements, write to the Product Development Department for practical recommendations.



2½" or 3½" square meter



4" x 6" rectangular meter
with mirrored scale
also available illuminated



2½" or 3½" round meter



Phaostron Instrument & Electronic Co.

151 PASADENA AVE., SOUTH PASADENA, CALIF.

CIRCLE 84 ON READER-SERVICE CARD FOR MORE INFORMATION

Shaft Position Encoder

Has Low Inertia



This is a new low inertia shaft position encoder designed specifically for use in high speed servo systems. The encoder utilizes a method of construction that results in lowering the inertia re-

flected into the servo driving system from 423 gm.—cm.² to 235 gm.—cm.².

These encoders are especially suitable for servo system applications, in that they provide an angular resolution of 0.3° or better (1000 counts in 360° or less), and can be mounted directly on the servo shaft. Thus, the encoder operates at relatively low speeds, and provides long life with reliable operation.

Since no gearing is required, a relatively low inertia load is reflected into the driving system (inertia is reflected as the square of the gear ratio). Thus, inertia effects are reduced permitting higher servo operating speeds.

Datex Div., G. M. Giannini & Co., Inc., Dept. ED, 918 E. Green St., Pasadena 1, Calif.

CIRCLE 85 ON READER-SERVICE CARD FOR MORE INFORMATION

Shield Insert Liners

Provide Excellent Cooling



A berillium copper spring finger liner material is available in sizes to fit all miniature JAN type shields. The individual finger liner insert, through spring

properties in the closely-spaced finger points, overcomes the shortcomings of the corrugated types of liners. The fingers of this insert liner can be depressed 0.100" without deforming, which is equal to three times the amount of spring movement required when in use on the tube.

The new liner affords substantial bulb temperature reductions of up to 30% as compared to the regular JAN shield when tested on a heat slug as described in MIL-S-9372C.

International Electronic Research Corp., Dept. ED, 145 W. Magnolia Blvd., Burbank, Calif.

CIRCLE 86 ON READER-SERVICE CARD FOR MORE INFORMATION

**CHICAGO
MAGNETIC**
solves
problems
in

TRANSFORMERS

TUNED FILTERS

**creative
engineering**

such as this*

Paired Filters



Matched

to tolerances of 0.1% through a temperature cycle of -67° F. to +190° F.

*designed and manufactured for a specific application in aircraft glidepath equipment.

**CHICAGO MAGNETIC
CONTROL**

1616 NORTH DAMEN AVENUE
CHICAGO 47, ILLINOIS

CIRCLE 87 ON READER-SERVICE CARD

ELECTRONIC DESIGN • July 15, 1956

Miniature Pressure Transducers

STATHAM UNBONDED STRAIN GAGE TRANSDUCTION

MINIMUM RESPONSE TO VIBRATION OR ACCELERATION

TEMPERATURE COMPENSATION OVER 315° F. INTERVAL

20 MILLIVOLTS AT 5 VOLT EXCITATION

PRESSURE ADAPTERS FOR CLOSED LINE APPLICATIONS

HOMOGENEOUS SENSING DIAPHRAGM SURFACE

NO EPOXY RESIN PRESSURE SEALS

MAXIMUM LINEARITY

ABSOLUTE PRESSURE
0-5 to 0-150 PSIA ... MODEL P130
DIFFERENTIAL PRESSURE
± 2.5 to ± 25 and 0-5 to 0-150 PSID ... MODEL P131
GAGE PRESSURE
0-5 to 0-150 PSIG ... MODEL P132



BULLETIN MPT-1

contains complete specifications on the foregoing pressure transducer models.

All matters pertaining to sale or use of instruments of our manufacture are handled by engineering personnel directly from our Los Angeles plant.

Please feel free to wire or telephone us collect whenever we may be of service.

Statham

LABORATORIES

12601 W. Olympic Blvd., Los Angeles 64, Calif

CIRCLE 89 ON READER-SERVICE CARD

Rate Gyro

Output Independent of Line Voltage



The motor of this unit is d-c powered and governor controlled so that the output is independent of line voltage. The size is 2-3/8" diam by 4-7/16" long and the weight is 1.7 lb. The case is designed to provide hermetic sealing.

Standard units incorporate a potentiometer pickoff and adjustable switches which can be set to close at any desired rate within the range of the unit. The standard unit also incorporates a dashpot for damping, and the natural frequency of the gyro is in the range of 5-10cy. The gyro is well suited for rate stabilization, position control, telemetering, and rate switching.

Globe Industries, Inc., Dept. ED, 1784 Stanley Ave., Dayton 4, Ohio.

CIRCLE 90 ON READER-SERVICE CARD FOR MORE INFORMATION

Capacitors

Have Low Inductance



This is a new line of low inductance capacitors designed for applications requiring high peak energy within a short time constant. They can be used for such applications as a precision light source for nuclear

research, energy sources for linear accelerators, or as pulsed r-f tank circuit capacitors.

The very low inductance of these capacitors is achieved through a design which reduces magnetic flux to a minimum. The result is a unit of not only high voltage and high capacitance but also high ringing frequency.

They are hermetically-sealed in a heavy-gauge welded steel case. Insulating creepage distance is provided by an insulating cover, which provides terminal access and keeps size to a minimum.

Electrodes are made of dead-soft, dry annealed aluminum foil, held to the closest tolerances. Stock ratings are available from 500 joules @ 25v with 0.025 µh inductance to 8000 joules @ 125kv with 0.065 µh inductance.

Axel Electronics Div., Axel Bros., Dept ED, 134-20 Jamaica Ave., Jamaica 18, N.Y.

CIRCLE 91 ON READER-SERVICE CARD FOR MORE INFORMATION



Actual Size CF 500

EIMAC FINGER STOCK

... for sliding contacts and
electrical weather stripping



Actual Size CF 600

Eimac preformed finger stock is the inexpensive, efficient answer to many circuit and equipment design problems . . .

Used for efficient electrical contact in high-frequency tuning devices, in coaxial tube sockets, for electronic weather stripping around access doors in equipment, and for dozens of other purposes, resilient silver-plated EIMAC finger-stock is outstanding.

EIMAC finger stock is accurately heat-treated to maintain uniform mechanical properties, can be fitted around a 1/2-inch radius, and may be fastened by screws, rivets, clamps or soft soldering.

A size for every need —

Single Edge	Width	Double Edge	Width	Klystron Types
CF-100	1 1/32	CF-200	1 3/16	CF-700
CF-300	3 1/32	CF-400	1 17/32	CF-800
CF-500	1 3/8	CF-600	2 1/4	

For further information write our
Application Engineering Department

EITEL-McCULLOUGH, INC.

SAN BRUNO CALIFORNIA
The World's Largest Manufacturer of Transmitting Tubes



CIRCLE 92 ON READER-SERVICE CARD FOR MORE INFORMATION

New

Fansteel

S-T-A SOLID
TANTALUM

CAPACITORS

Engineering
Samples NOW
AVAILABLE!

STA
100

STA
200

STA
300

S-T-A 100 Series rated 35 volts, 1 mfd to 2 volts, 17 mfd

S-T-A 200 Series rated 35 volts, 5 mfd to 2 volts, 83 mfd

S-T-A 300 Series rated 35 volts, 20 mfd to 2 volts, 220 mfd

For further information, write for Bulletin 6-530 or
contact the Fansteel office nearest you.

Visit FANSTEEL Booths 327 and 328, WESCON, Los Angeles.



C566A

FANSTEEL METALLURGICAL CORPORATION
North Chicago, Illinois, U. S. A.

TANTALUM CAPACITORS . . . DEPENDABLE SINCE 1930

CIRCLE 94 ON READER-SERVICE CARD FOR MORE INFORMATION

80kw Power Supply

Up to 20kv D-C Output



Designed for powering the pulse modulator section of high voltage pulse test stations, this mobile, completely self-contained power supply delivers up to 20kv d-c output at 4amp, with less than 1% ripple. The

equipment operates from a 208v, 3-phase, 60cy input source and provides a continuously variable output from zero to maximum rating that is regulated to within 15% from no load to full load conditions.

Some advanced features of this equipment include: overload and overvoltage circuits which remove the output power when either the current or voltage exceeds pre-selected values; an automatic shorting circuit to discharge HV to ground after the set is de-energized; and automatic re-cycling of output voltage to zero on overload. In addition, remote control operation of all switch functions is possible.

Manson Laboratories, Dept. ED, 207 Greenwich Ave., Stamford, Conn.

CIRCLE 95 ON READER-SERVICE CARD FOR MORE INFORMATION

Insulation Block

Has Improved Strength



This is a new high heat - resistant, lightweight, bonded Fiberfrax ceramic fiber block designed for high temperature insulation. Resistant to temperatures up to 2300°F and chemically inert, the F-20 Fiberfrax blocks withstand flame impingement and are unaffected by furnace atmospheres.

The block has an approximate density of 20 lb/cu ft, which is about 7 lb more than the original F-13 block. Thermal conductivity is 1.27 BTU/hr, sq ft and °F/in of thickness at a mean temperature of 1000°F; at 2000°F it is 2.24.

Standard size are 12" x 12", 18" x 12", 18" x 6", 36" x 6" and 36" x 12", in thicknesses ranging from 1-1/2" to 4" in 1/2" increments.

The Carborundum Co., Dept. ED, Niagara Falls, N. Y.

CIRCLE 96 ON READER-SERVICE CARD FOR MORE INFORMATION

KAY LAB
CALIFORNIA

STABILITY  Locked in!
WITH CHOPPER AMPLIFIERS

**MEASURE
AMPLIFY**
μV...μA



MODEL 203

KAY LAB DC Microvoltmeters measure and amplify, exceptionally small DC voltages and currents, with unequalled stability. Zero centered mirrored scale for reading speed and accuracy.

SPECIFICATIONS

- 100 uv to 1000 v
- 100 uua to 100 ma
- 25 ranges
- 100 megohms input
- 80 db gain as amplifier
- 10 uv equivalent drift
- 1 v output

Price \$550.00

Representatives in all major cities

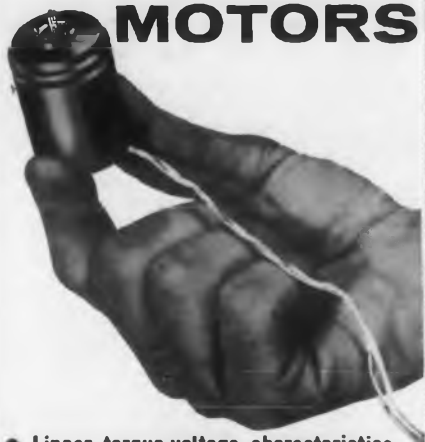
KAY LAB

5725 KEARNEY VILLA ROAD
SAN DIEGO 12, CALIFORNIA

CIRCLE 97 ON READER-SERVICE CARD

Now on the shelf!

PRECISION SERVO MOTORS



- Linear torque-voltage characteristics
- Linear torque-speed characteristics
- Withstand continuous stalling
- High torque efficiency

**Guaranteed
shipment
within 10 days
for these units:**

(Subject to prior sale)

CIRCLE THE MOTORS FOR WHICH YOU ARE INTERESTED IN HAVING PRICES AND DATA	WATTS	CYCLES	VOLTAGE	
			SUPPLY	CONTROL
1/2	400	115	180	180
1 1/2	60	115	180	180
2 1/2	60	115	115	115
5	60	115	115	115
5	400	115	115	115
5	60	115	250/250	250
5*	60	115	250/250	250
5	400	115	250/250	250
5*	400	115	250/250	250
10	60	115	115	115
10	400	115	115	115
10	60	115	250/250	250
10	400	115	250/250	250
10**	400	115	57.5/57.5	57.5

*Have double shaft extension (all others are single).
**Designed for mag-amp systems.

Mail this coupon to:

FORD INSTRUMENT COMPANY
DIVISION OF SPERRY RAND CORPORATION
31-10 Thomson Ave., Long Island City 1, N. Y.
Attention: Component Sales ED

OR, call or wire R. Banka for prices
(Stillwell 4-9000, Ext. 513).

Please send me prices on the servo motors I have circled above.

Please send me fully illustrated data bulletin giving specifications and performance information.



Name _____
Position _____
Company _____
Street _____
City _____ State _____

CIRCLE 99 ON READER-SERVICE CARD

Low-Frequency Oscilloscope

Has 2 Identical Amplifiers



The new l-f oscilloscope Model 130A has nearly identical horizontal and vertical amplifiers. The amplifiers provide a max sensitivity of 1mv/cm or 10mv full scale deflection with pass bands from d-c to 300kc, and can accept balanced inputs on the five most sensitive ranges.

The Model 130A sweep circuit employs a linear Miller-integrator triggered sweep producing an accurate calibrated sweep, from 1µsec/cm to 15sec/cm.

Etched circuitry is used extensively to stabilize capacities, sectionalize circuitry, and increase operating dependability. The mono-accelerator cathode ray tube replaces through the front panel by removing a twist-off bezel which also locks in place to support conventional camera equipment.

Hewlett-Packard Co., Dept. ED, 295 Page Mill Rd., Palo Alto, Calif.

CIRCLE 100 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Attenuators

Parallel Vane Type



Seven new calibrated variable attenuators, Models 701, 702, 749, 751, 752, 753, and 754 comprise an uninterrupted series for the frequency range of

2600 to 18,000Mc. These attenuators are all of the parallel vane type with dissipative element of pyrex glass vane and an evaporated nichrome film. The precise lead screw is driven by duo-dial to provide convenient, accurate measurement of the displacement of the dissipative element. Calibration is accurate to 0.3db, precise, permanent, and not affected by humidity or temperature variations. A large calibration chart is supplied with each attenuator.

The attenuators range from frequencies of 2.60-3.95kMc in Model 754 to 8.20-12-4kMc for Models 701 and 702. The general attenuation range is 0.5 to 40db except in model 702 where the range is 0.5 to 10db with a calibration accuracy of 0.2db. Maximum VSWR is 1.15.

The Narda Corp, Dept. ED, Mineola, N. Y.

CIRCLE 101 ON READER-SERVICE CARD FOR MORE INFORMATION

FANSTEEL

SELENIUM RECTIFIERS



One Word Tells
the Story....

Dependable!

Write for Bulletins 6.400, 6.401

FANSTEEL METALLURGICAL CORPORATION
North Chicago, Illinois, U.S.A.

DEPENDABLE RECTIFIERS SINCE 1924

CIRCLE 102 ON READER-SERVICE CARD FOR MORE INFORMATION



One of a series depicting missiles "Yesterday, Today and Tomorrow"

of men, missions and missiles...

The ancients' bow and arrow, today's guided missile, and tomorrow's space ship have one thing in common. They are all guided missiles. The problems of aerodynamics, guidance and propulsion remain basic. Early man solved his problem with raw materials and native ingenuity. Now the problems are much more complex, requiring the best our civilization can produce. Today, such problems are best solved by highly organized and creative engineering teams. These teams are even now supplying the building blocks for tomorrow's achievements.

At Bell there are no limits to engineering advances. Our engineering teams are engaged in advanced missile projects in the supersonic and hypersonic range. These projects offer unlimited opportunity for *individual* ability in professional and financial advancement for those possessing a B.S. or advanced degree in:

- AERONAUTICAL ENGINEERING
- ELECTRONIC ENGINEERING
- MECHANICAL ENGINEERING
- MATH OR PHYSICS

Arrange to see our representative on campus, or write for your copy of our brochure "ENGINEERING OPPORTUNITIES".

Manager, Engineering Personnel; Dept. 48



POST OFFICE BOX 1
BUFFALO 5, NEW YORK

Digital Flow Indicator

Compact, Packaged System



Model 5692 digital flow indicator is designed to fill the need for a testing instrument compact enough to move from test bench to test

bench for calibrating flow meters and making actual flow measurements.

Its unusual front panel features a 4-digit presentation reading directly in either lb/hr or gallons. Direct flow rate indication runs from zero to 9999 lb/hr. The time base may be selected from 1millisec to 10sec, in increments of 1millisec.

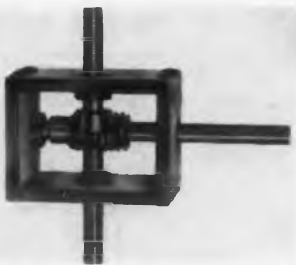
Model 5692 includes complete test and flow totalizing qualities, and is engineered to operate with any impeller type transducers. A complete test feature checks the entire operation and indicates on the four banks of decimal counting units the actual time base chosen. Accuracy is ± 1 count, and time base stability is one part in 10^5 short term. Sensitivity is 5mv at 5cy.

Berkeley Div. Beckman Instruments, Dept. ED, 2200 Wright Ave., Richmond 3, Calif.

CIRCLE 105 ON READER-SERVICE CARD FOR MORE INFORMATION

Right Angle Drives

Feature Dual Output Shafts



Featuring dual output shafts, two basic types are available with a variety of input-output ratios, a bevel gear assembly, and a worm gear assembly. Both are assembled in anodized

aluminum dust-proof housings, measuring 1" x 1-1/2" x 1-1/2", with gears permanently pinned to stainless steel shafts mounted in bronze bearings with constant pressure thrust washers.

The BG series employs precision bevel gears and is available with input-output ratios of 1:1, 2:1, and 3:1. The WG series, worm gear assemblies, are especially suited to handling spring or gravity loaded controls, as the output shaft automatically locks in position with the input shaft remaining free for smooth drive in either direction. The WG series is available with the following input-output ratios: 5:1, 10:1, and 20:1.

Jan Hardware Mfg. Co., Inc., Dept. ED, 75 N. 11th St., Brooklyn 11, N.Y.

CIRCLE 106 ON READER-SERVICE CARD FOR MORE INFORMATION

Lerco

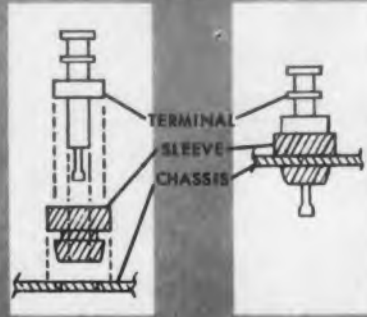
electronic hardware

now...

TEFLON[®]

SNAP-LOCK terminals

ACTUAL SIZE



- new principle (patent pending) eliminates terminal boards
- terminals install directly in chassis
- provides ground ring for sensitive circuits

Lerco's new Teflon insulated terminals make possible new design methods which eliminate terminal boards. The terminals, individually insulated from the metal by Teflon, may be installed directly in the chassis. First, the Teflon sleeve is snapped through a hole in the chassis. Then the terminal is inserted and swaged over the insulator to lock the assembly solidly in place. Lerco Teflon insulated terminals will withstand severe shock and vibration conditions.

The Lerco terminals (patent pending) are now produced in sizes for .035, .050, and .062 thickness material. Illustrated above is Number 4075. For other variations now available and for further information, write for complete brochure.

® Dupont trade mark

ALWAYS CALL LERCO FOR

- Diode clips • Terminals
- Terminal boards
- Taper pin terminals
- Stand-offs • Plug assemblies
- Inserts • Sockets
- Receptacles • Bushings
- Printed circuit hardware

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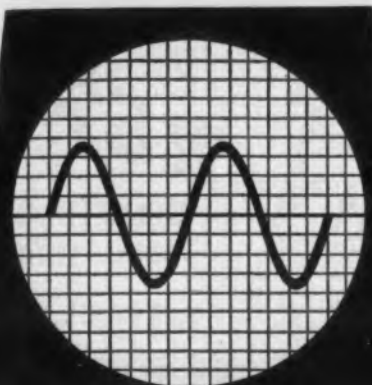
Lerco

ELECTRONICS, Inc.

501 South Varney Street
Burbank, Calif. • Victoria 9-5556



CIRCLE 107 ON READER-SERVICE CARD



*you'll check
waveshapes
much faster
with a*
SWEEP-SYNC



new automatic sweep generator eliminates manual oscilloscope adjustments

This instrument frees you from the tedious, time-consuming job of manipulating controls. Hooked up to your cathode-ray oscilloscope, it adjusts automatically every time you change signal frequency. Change it 10... 50... 500 times an hour—the display comes up unaltered, and with the preset number of cycles. You never lose the display. Hence all the time you now spend setting and resetting dials is put to productive use. You get more work done, with less distraction.

Trigger input — any waveshape 5 cps to 100,000 cps. Output is sawtooth, approximately 10 V.P.P. The SWEEP-SYNC saves time in circuit development, production testing, and waveshape monitoring... makes many visual techniques practical. Occupies only 4" of front panel width. Write for literature.



**CHADWICK
HELMUTH
COMPANY**

472 East Duarte Road
Monrovia, California

CIRCLE 109 ON READER-SERVICE CARD

Force Transducer

Has 20,000 lb Capacity



This transducer is an SR-4 load cell of 20,000 lb capacity with max deflection of only 0.005" under full load. This provides a natural mechanical frequency re-

sponse of about 1900cy, more than twice that of previous cells. Full capacity thrust on this cell was measured in 3μsec during a rocket test.

SR-4 resistance wire strain gages used in these cells have almost instantaneous electrical response to strain. Another feature of these Type 9236 cells is the use of two independent strain gage bridge circuits to permit producing two independent records of thrust with associated instrumentation systems. One circuit is used with an oscillograph to measure the peak transient thrust that occurs during the first few milliseconds of firing. The other bridge circuit is wired to permit higher input voltages and consequent higher output voltage.

Baldwin-Lima-Hamilton Corp., Dept. ED, Philadelphia, Pa.

CIRCLE 110 ON READER-SERVICE CARD FOR MORE INFORMATION

Utility Ovens

Ranges From 100°C to 1000°C



This is a new line of 4 junior sized utility ovens for small batch drying, curing, baking, processing, heat treating, product control and sample testing. The 4 models have approx 2' x 2' x 2' oven interior dimensions, but vary in temperature ranges from from 100°C to 1000°C.

A true forced air recirculating system is maintained within the oven chamber through use of a fan and controlled intake and exhaust vents. A shielded heating element prevents radiant over-heating and aids in a more even temperature control throughout the chamber.

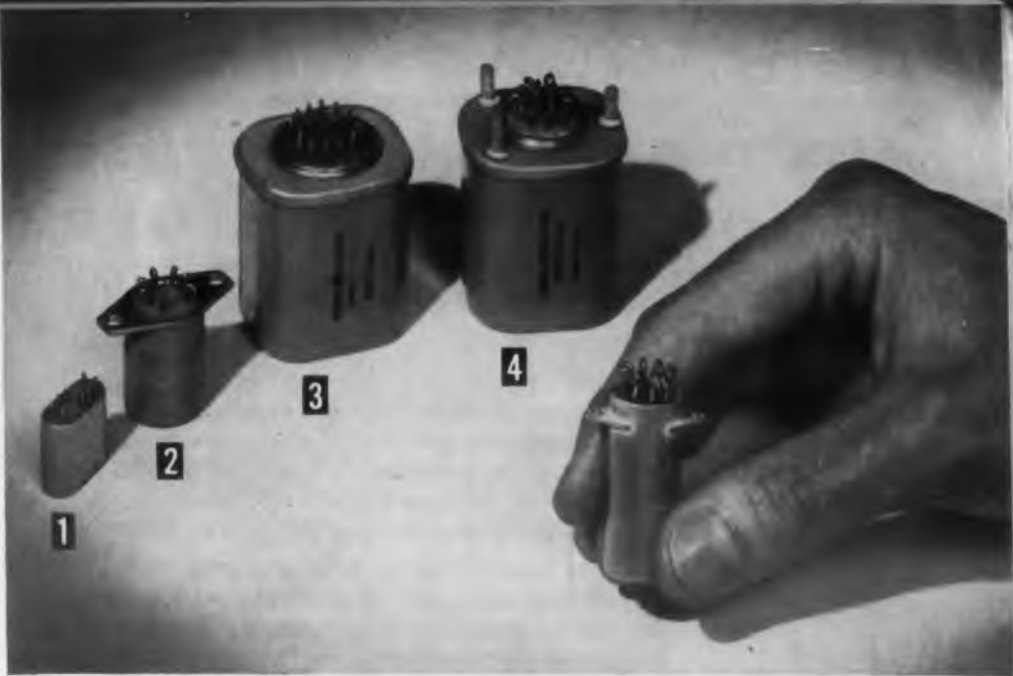
The interior of the oven is lined with Armco aluminized sheet steel allowing quick, easy cleaning of the entire chamber. A drip pan collects and disperses any accumulated moisture and aids in keeping a non-contaminating interior.

Ovens operate at 110 and 220v, but can be modified to conform to any non-standard power supply.

New England Oven and Furnace, Dept. ED, Orange, Conn.

CIRCLE 111 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 112 ON READER-SERVICE CARD



NOW—G.E. adds 2PDT sub-miniature to small sealed relay line

Now—to give you still more flexibility in applying General Electric hermetically sealed relays to your electronic systems—G-E engineers have developed the new 2PDT sub-miniature. Like other ratings in the G-E sealed-relay line, this new unit combines small size with unusual reliability under severe temperature, shock, and vibration conditions—making it ideal for air,

sea, as well as ground applications. **Description:** .651 in. in diameter, 1.6 in. long; weighs one ounce. Unaffected by vibrations of 10 to 55 cps at .12 in. maximum excursion or 55 to 500 cps at 15Gs acceleration. Withstands shock tests in excess of 50Gs. Operates in ambients of 125 C. Available in a wide variety of coil ratings.

4 MORE G-E SEALED RELAYS YOU CAN USE

1 Micro-miniature relay: Weighs only .35 oz, measures .34 in. by .78 in. by .84 in. Rated 2 amp resistive at 28 v DC or 115 v AC. Also available in current-sensitive models. Standard relays withstand ambient temperatures of 125 C, and 20Gs acceleration at 50 to 500 cps.

2 Sub-miniature SPDT relay: This rugged relay weighs only .9 oz and occupies less than .8 cu. in. of space. Available for d-c or 400-cycle a-c operation. Contacts are rated 2 amp at 28 volts DC or 115 volts AC.

3 High-speed 4PDT relay: Is especially designed for use where operation as fast

as 500 microseconds is required. Weighing only 5 oz and measuring $1\frac{1}{8}$ in. by $1\frac{1}{2}$ in. by $2\frac{3}{4}$ in., it is ideal for such applications as ground-based radar, multiplexing of electronic signals, and computer circuits.

4 Miniature relay: Over 300,100,000 operations without a miss is the record of a typical model of this relay. After the 200 millionth operation there was less than 3 mils wear between the armature tail piece and the contact lifter. Available in 2-, 3-, or 4-pole double throw and 6-pole normally open forms. Rated 5 amp at 28 volts DC at 85 C.

MAIL TODAY FOR G-E RELAY DATA

General Electric Co., Sect. E792-4, Schenectady 5, N. Y.

- | | |
|---|--|
| <input type="checkbox"/> NEW 2PDT Sub-miniature—Bulletin GEA-6412 | <input type="checkbox"/> High-speed 4PDT Miniature—Bulletin GEA-6212 |
| <input type="checkbox"/> Micro-miniature—Bulletin GEA-6346 | <input type="checkbox"/> Miniature—Bulletin GEA-6213 |
| <input type="checkbox"/> SPDT Sub-miniature—Bulletin GEA-6211 | <input type="checkbox"/> HAVE G-E SALES ENGINEER CALL |

NAME..... TITLE.....
 COMPANY.....
 ADDRESS.....
 CITY..... STATE.....

GENERAL  ELECTRIC

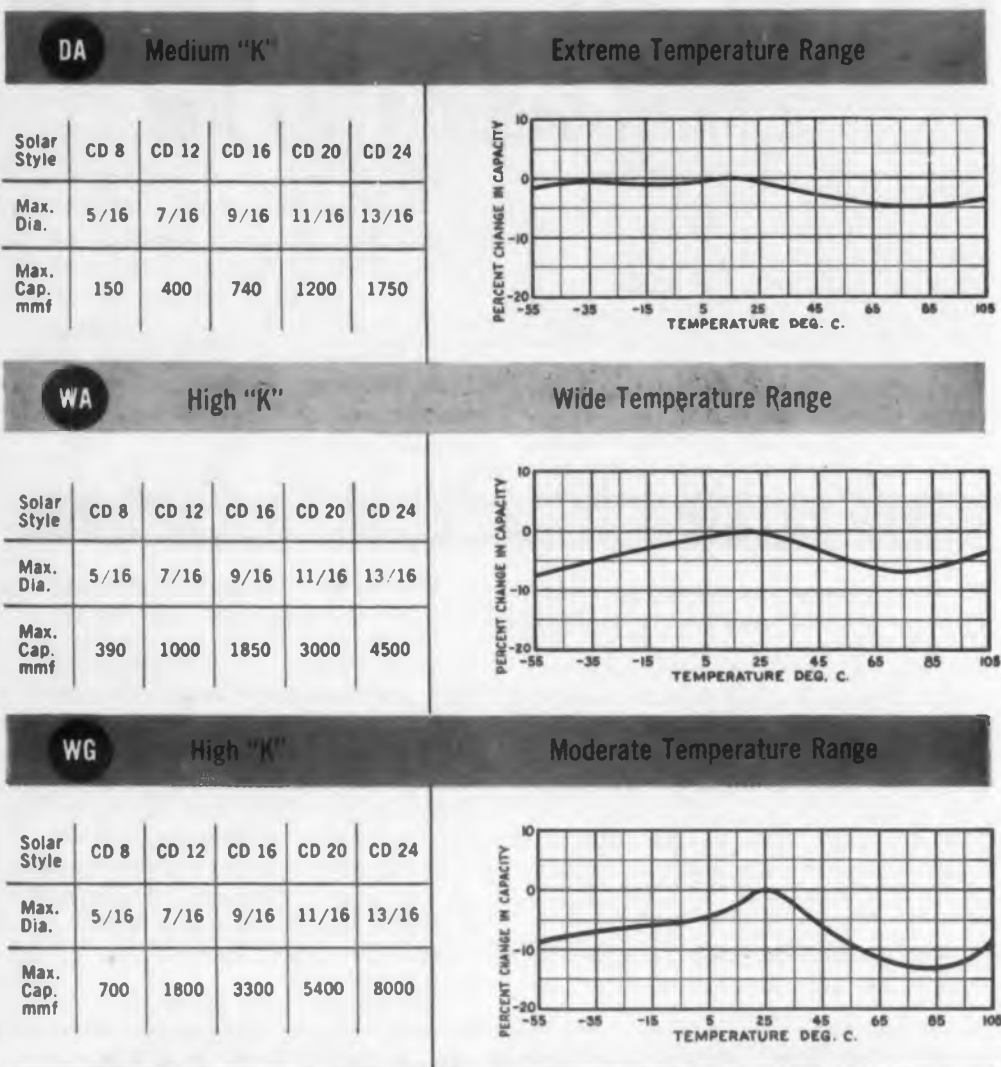
exceptionally stable by-pass capacitors

— Solar ceramic bodies DA, WA & WG



Constantly advancing Solar research brings you small-size discs in unusually stable bodies. Solar's technically proven ceramic formulations provide flat temperature coefficient and low power factor throughout a broad capacity range. These discs are available not only in GMV, but due to their stability can be produced to 10% and 20% tolerances.

A ceramic formulation can be furnished to yield optimum performance under conditions of your particular application. Capacities for typical ranges are shown below. Note the unusual stability of the new "WG" Body for radio and television temperature range.



Normal Ratings: 500 V; 1½% max. PF; min. IR; 7500 Meg.

Write for literature, or the complete Solar catalog.

SOLAR MANUFACTURING CORP.
New York, N. Y.

"QUALITY ALWAYS"



SALES OFFICES: 46th & Seville, Los Angeles 58, Calif.
4000 W. North Ave., Chicago 39, Ill.

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CIRCLE 114 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Transistor Thermometer

With High Thermal Impedance



The Model 1 thermometer is a battery powered instrument for measuring temperature in the 35 to 85°C range. The high thermal impedance of the sensing element gives this unit, as a thermometer, the

same freedom from loading the thermal path that a VTVM has in an electrical circuit. In addition to this performance feature, a mounting convenience is also included.

The sensing element is enclosed in insulating material and shaped like a washer so that it may be used as the insulating washer normally used for mounting the transistor. This point is the closest available point to the heat source that does not require breaking the thermal flow or modifying the transistor.

The penlite battery which is readily removable from the bottom of the instrument, yields about 250 hours of service. The measuring unit is 4" wide by 6" long and 2-5/8" high. The 36" cord from the sensing element plug attaches to the measuring unit with a miniature plug.

B & B Engineering Associates, Dept. ED, RFD #1, Concord, N.H.

CIRCLE 115 ON READER-SERVICE CARD FOR MORE INFORMATION

Phase Indicator

No Tubes, Batteries, or External Power



Model 400 P Phaseometer requires no tubes, no batteries or external power. It is designed to measure any phase shift network between input and output, analog computer circuits, electronic and

mechanical choppers, production comparison of capacitors, inductances, etc.

The Model 400 P has direct reading indicator digital readout to 0.1° with no chart conversion. No special equipment is required for calibration. Frequency range is 350cy to 15kc, usable to as low as 40cy. Accuracy at 400cy is $\pm 0.25^\circ$ or better.

Winco Electronics, Dept. ED, 644 No. Hawthorne Blvd., Hawthorne, Calif.

CIRCLE 116 ON READER-SERVICE CARD FOR MORE INFORMATION

It's **NEW!**

**ORBITRAN
MODEL 1000-A**

**AN EXTERNALLY
TRIGGERED**

precision digital

PULSE DELAY

GENERATOR



**1 - 1000 μ sec.
0.1 μ sec. steps**



ACCURATE

$\pm 0.01\%$ OR 0.05 μ SEC.



STABLE

LESS THAN 0.005 μ SEC. JITTER
LESS THAN 0.005% CHANGE
IN DELAY WITH CHANGE IN PRF



VERSATILE

EXTERNAL OR INTERNAL TRIGGER
SINGLE OR PAIRED PULSE OUTPUT
DELAYED SCOPE TRIGGER IN
ADVANCE OF DELAYED PULSE
BUILT IN CALIBRATOR

Send for complete specifications

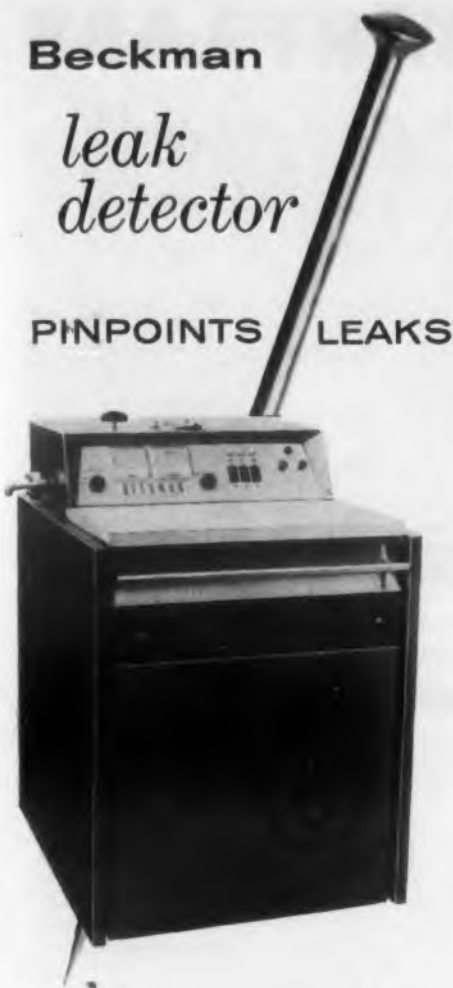
ORBITRAN COMPANY
LAKESIDE CALIFORNIA

CIRCLE 117 ON READER-SERVICE CARD

Beckman

leak
detector

PINPOINTS LEAKS



THE BECKMAN LEAK DETECTOR finds leaks with production-line speed in vacuum, pressure and hermetically-sealed systems and units of any size. It is useful in the manufacture of instrument and electronic components, testing glass-to-metal seals and welded or soldered joints, maintenance of pressure and vacuum processing systems—wherever operating and shelf life and system efficiency are sharply reduced if even normally insignificant leaks are present.

A unique radio-frequency principle makes the Beckman Leak Detector a simpler, more reliable and less expensive mass spectrometer leak detector. It is sensitive to leakage rates down to 10^{-9} standard cc/sec., it is easy to use and completely safe for operator and system under test because inert helium is the leak tracing agent, and it is portable and dependable. Write for Data File N20-57 to Beckman Instruments, Inc., Process Instruments Dept., Fullerton, California.

Beckman *process instruments*

CIRCLE 119 ON READER-SERVICE CARD

Parabolic Antenna

New Parabolic Grid Structure



This is a new series of parabolic antennas for the 890-960Mc and 450-470Mc regions. Units are now available in sizes up to 10 ft diam employing a newly-developed parabolic grid structure which materially reduces weight and wind loading while retaining all of the electrical properties of a solid spun dish at frequencies up to 1000Mc.

At 960Mc three models are available: Model P-942, Model P-972, and Model P-9120 are 42", 6 ft, and 10 ft in diameter and produce gains of 15, 20, and 25db over a dipole. At 460Mc two units are available: Models P-472, and P-4120, are 6 ft and 10 ft in diameter and produce gains of 15 and 20db over a dipole.

Mark Products Co., Dept. ED, 6412 W. Lincoln Ave., Morton Grove, Ill.

CIRCLE 120 ON READER-SERVICE CARD FOR MORE INFORMATION

Shielded Container

For Magnetic Tape



This is an entirely new type of protective carrying and storage container which completely shields tape recordings from high and low in-

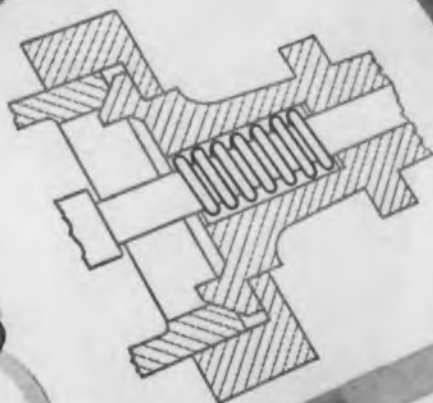
tensity fields which might cause double sound, echo, or partial or full erasure. It also shields delicate instruments in government and other laboratories. The container is available in a variety of sizes and shapes to fit any desired application.

Double metal construction consists of two layers of specially prepared magnetic shielding steel, known as Fernetec, which attenuates high intensities and Co-Netic, which attenuates low intensities. The layers are rendered non-shock sensitive by coating both sides of each layer with specially developed ferrous and ferrite powders which raise the metal's saturation point considerably. The high saturation point and non-shock sensitive features insure lasting safety to tape recordings and delicate instruments.

Magnetic Shield Div., Perfection Mica Co., Dept. ED, 20 N. Wacker Dr., Chicago 6, Ill.

CIRCLE 121 ON READER-SERVICE CARD FOR MORE INFORMATION

I-S BERYLLIUM COPPER SPRINGS



**...micro-
processed**

**to meet your most exacting
spring specifications**



For High Strength and High Endurance — specify microprocessed I-S springs of beryllium copper. These unique springs are particularly suited for applications requiring non-magnetic, corrosion-resistant properties, with excellent electrical conductivity, and stability. The inherent advantages of this ideal spring material — combined with I-S specialized engineering techniques in manufacture — assure absolute conformity to your critical spring requirements.

I-S Design Service saves you time and money! For recommendations on specific spring problems, check with I-S. Samples and short runs can be supplied quickly and economically!

For Additional Information consult Sweet's Product Design File or write for our latest Catalog.

**INSTRUMENT
SPECIALTIES CO. INC.**

270 Bergen Blvd., Little Falls, N.J.
Telephone: Little Falls 4-0280



CIRCLE 122 ON READER-SERVICE CARD FOR MORE INFORMATION



True sine and square waves for servo, geophysical, and computer work. 0.01 to 1000 cps in 5 decades. High stability, low distortion. Accurate frequency calibration and precisely metered output.

**DONNER MODEL 15
LOW FREQUENCY
GENERATOR**

\$365, F. O. B. Berkeley

ADVANCED INSTRUMENTATION

Versatile engineering tool solves both differential equations and transfer functions. Detachable problem boards, plug-in components. Function generator, multiplier, other accessories available. High accuracy with operating simplicity.

**DONNER MODEL 30
ANALOG
COMPUTER**

\$995, F. O. B. Berkeley



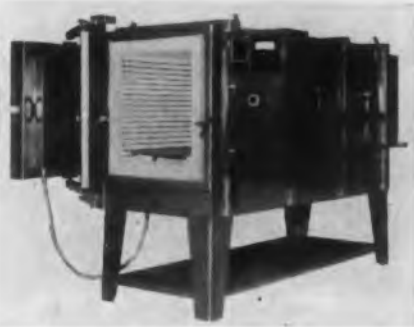
DONNER SCIENTIFIC
COMPANY

2827 Seventh St.
Berkeley 10, Calif.

Complete Data
on Request

CIRCLE 124 ON READER-SERVICE CARD FOR MORE INFORMATION

Furnace Has Six Zones



This furnace is designed for many critical temperature heat treating operations such as annealing large intricate assemblies of laboratory glass, pro-

duction heat-treating metal, etc., where furnace gradients must be controlled closely.

The interior dimensions of this furnace are 24" wide x 24" high from hearth to roof and 72" long. Not only is temperature evenness easily attained but different temperatures in different parts of the furnace are easily controlled and indicated by means of the thermocouple selector switch.

There are six zones in the furnace, the input to each controlled by an input controller which may be set from 7% to 100% of input in increments of 1%, giving precise control over the rate of heating in that zone. Any rate of heating up time may be selected enabling control over product uniformity.

L&L Manufacturing Co., Dept. ED, 136 8th St., Upland, Del. Co., Pa.

CIRCLE 125 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Connectors In 20 and 27 Contacts



This new Series 18 precision Continental Connector is available in 20 and 27 contacts. They provide a larger, more rugged contact with the same efficient spacing used on the Series 20. The 0.053" diam solder cup can accommodate

two #20 wires, if necessary.

Outstanding features include non-rotating, floating contacts that assure self-alignment of each individual contact. This reduces the engagement and disengagement force normally encountered when using connectors with fixed contact.

Clear anodized, aluminum hoods provide positive cable support and strain relief. Positive polarization is achieved through the use of a reverse type guide pin and guide socket arrangement. A polarizing screwlock guide pin and guide socket are also available in this series connector.

DeJUR-Amsco Corp., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N.Y.

CIRCLE 126 ON READER-SERVICE CARD FOR MORE INFORMATION

BART LABS

a prime source for
precious metal plating
and precision electro-
forming



BART
PRECIOUS
METAL
PLATING
SERVICE

"ARMOR-CLADDING" propeller blades with nickel for commercial and government air-craft, AEC development work,— these typify our many patented processes and vast facilities.



PRECISION
LECTRO-
FORMING
PROCESS

We can reproduce any intricate shape to precise dimensions...no secondary operations to alter tolerances.
14-1/2" U.S.
Pat. Offs.



BART Laboratories has been serving government and industry for 44 years. Now, with greatly expanded facilities, BART invites new accounts. BART LECTROFORMING provides product design engineers with unlimited flexibility and, combined with our exclusive Precious Metals Plating Techniques, offers excellent opportunities for creative engineering.

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Dept. ED-7, 227 Main Street, Belleville 9, N. J.
Pioneers in Rhodium Plating and Electroforming of Reflectors, Electronic and other Precision Parts.

CIRCLE 127 ON READER-SERVICE CARD

RELIACAP®

Mylar Fixed Capacitor



A high quality, reliable mylar capacitor designed for standard and sub-miniature packaging of military or commercial equipment.

FEATURES

- Sealed in Kel-F** for moisture resistance
- Convenient form factor
- High insulation resistance
- Excellent temperature characteristics
- Two sets of parallel leads
- Lightweight

The Sanders Reliacap® Mylar* Capacitor is a flat, thin, compact capacitor which may be stacked or mounted in any convenient manner in sub-miniature packaging. Two pairs of parallel leads facilitate mounting and securing the Reliacap.

Reliability is achieved by sealing in a tough Kel-F jacket (which is impervious to moisture) with a resultant high insulation resistance, and by using at least 2 layers of Mylar film dielectric. Most sizes are made with 3 layers of mylar film. The Kel-F jacket is also chemically inert, thereby permitting use of the Reliacap in applications where oils, chemical agents or gases may affect components.

GENERAL SPECIFICATIONS

- Temperature Range:** -55°C to +125°C.
Tolerance: ±5%, ±10%, ±20%
Insulation Resistance (Megohm x MFD): 500 at 125°C.
Power Factor: 1% Max. at 1,000 cps.
Moisture Resistance: Will meet requirements of MIL-C-91

Write for complete information:

Sanders Associates, Inc.
95 Canal Street
Nashua, New Hampshire

Visit the Sanders Exhibit at
the Wescon Show—Booth 1608

*Trademark of DuPont
**Trademark of M. W. Kellogg Co.
®Trademark Sanders Associates



CIRCLE 129 ON READER-SERVICE CARD

Magnetic Cartridge

Made in Two Series



This cartridge is available only in single stylus and is designed to fit into all professional arms with 1/2" center-spaced mounting holes or stand-offs.

In order that the B&O Special may be used with high level magnetic input professional amplifiers and also with amplifiers having only low level magnetic input, it is made in two series: B&O 350 A+ Special with 350 ohm d-c resistance having 30mv output at 4.4cm/sec (black body and red lettering); B&O 72 A+ Special with 72 ohm impedance having 15mv output at 4.4cm/sec (black body and gold lettering).

The B&O Special has the same 8-pole construction as the standard series. This permits high output and excellent signal-to-noise ratio on low impedances.

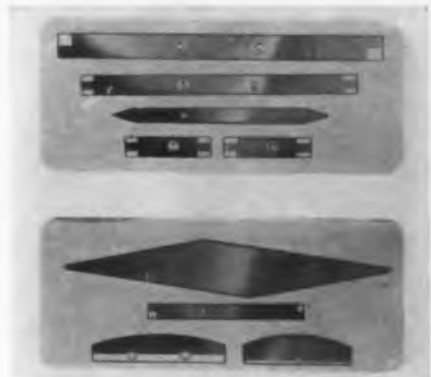
Fenton Co., Dept. ED, 15 Moore St., New York 4, N. Y.

CIRCLE 130 ON READER-SERVICE CARD FOR MORE INFORMATION

Attenuator Plates

Metalized Glass

These elements meet Government Specification MIL-A-11052A, and are available in six specific sizes for use with waveguides RG-48/U, RG-49/U, RG-50/U, RG-51/U, RG-52/U, and RG-91/U.



The metalized resistance elements, manufactured by evaporating pure metals in high vacuum to a glass base, are highly stable, unaffected by humidity, controllable as to resistance, and are reproducible. The films are negligibly thin compared to the highest microwave frequencies; they are non-inductive, and their noise level is barely measurable.

By precise measurement during evaporation, the resistance films are held to an accuracy of 1% and they offer an extremely low temperature coefficient of resistance of approx 75ppm/°C.

Metavac, Inc., Dept. ED, 45-68 162nd St., Flushing 58, N. Y.

CIRCLE 131 ON READER-SERVICE CARD FOR MORE INFORMATION

ENGINEERED CABLE SYSTEMS BY PACIFIC AUTOMATION ARE RELIABLE SYSTEMS



SYSTEM DESIGN

In your own plant our engineers can specify and design cable and cable components to meet your exact SYSTEM requirements.

SYSTEM FABRICATION

At our modern cable plant we build custom-made cable with facilities for braiding and molding main braid-on braid increases and attaching and "locking" components so that a complete SYSTEM hook-up is provided.



SYSTEM INSTALLATION

On-site installations of cables and block assemblies of our custom-made cables and components are supported by our field engineers to provide complete SYSTEM integration.

SYSTEM CHECK-OUT

Testing of on-site installations for circuitry by Pacific Automation Products engineers ensures functional reliability of the electrical SYSTEM.

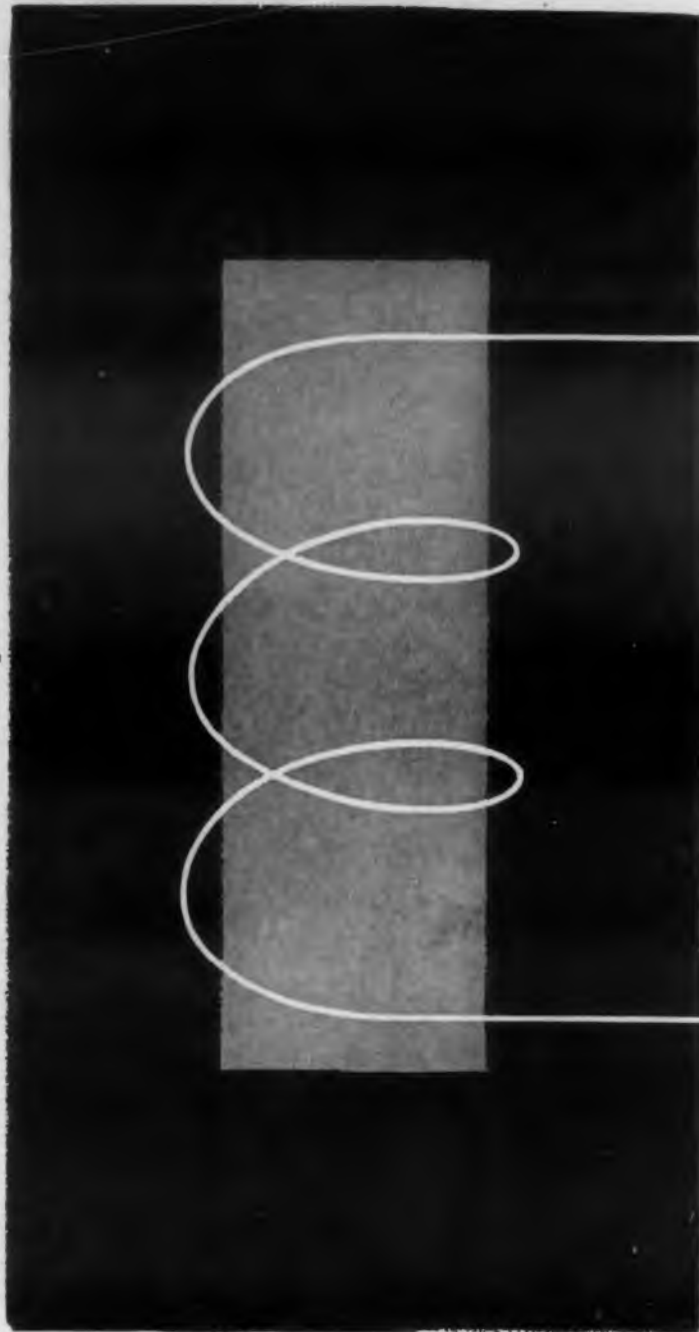


Write for Bulletin 156



Pacific Automation Products, Inc.
1000 AIR WAY, GLENDALE 1, CALIF.

Engineers and technicians will find a challenging and fascinating career with us. Your qualifications are welcomed.



**+ Positive Winding
- Negative Downtime
with ESSEX Extra Test®
MAGNET WIRE**

Positive winding... negative downtime characterize the use of Essex Extra-Test®

Magnet Wire. It stems from highly developed quality control based on tests exceeding the normal standards... often by substantial margins. Extra-Test® means EXTRA VALUE... specify Essex!



**EXTRA TEST
ESSEX MAGNET WIRE**

**DIVISION ESSEX WIRE CORPORATION
Fort Wayne 6, Indiana**

MANUFACTURING PLANTS — Birmingham, Alabama; Anaheim, California; Fort Wayne, Indiana; Detroit, Michigan.

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CIRCLE 134 ON READER-SERVICE CARD FOR MORE INFORMATION

72

Power Supply

225-325v d-c at 175ma



Model RS-317 is a compact power supply designed to provide excellent regulation characteristics over the extensively used voltage range of 225-325v.

The supply is complete, ready to operate, has a line cord

and plug. Barrier-type terminal strip on the rear face of the chassis provides convenient connections for regulated d-c as well as a heavy duty, 6.3v filament winding.

Specifications of the unit are: line regulation: less than 5mv/v a-c; internal impedance: less than 0.5 ohms in series with an inductance of less than 1 μh; recovery time: less than 25μsec; ripple and noise: no load—less than 500μv, rms; full load—1500μv, rms; current range: 0-175ma, continuous duty.

Trans Electronics Co., Dept. ED, Canoga Park, Calif.

CIRCLE 135 ON READER-SERVICE CARD FOR MORE INFORMATION

Multi-Circuit Timers

In Various Switch Combinations

This unit is made only to individual specifications and utilizes a standard Bristol "Circle B" synchronous timing motor and snap-action enclosed switches rated at 15 amp, 125v a-c.



It is available in various switch combinations and is normally made with pre-set factory-adjusted cams and cam settings.

Cam speeds are available in ranges from 1 rev/sec down to 1 rev/month, and the entirely enclosed construction provides a high degree of dependability and accuracy.

The unit pictured is approx 3" high, by 2" wide, and with 4 switches, is approx 4" long. It is intended for applications such as appliance timers, industrial controls, control applications, etc.

The Bristol Motor Div., Vocaline Co. of America, Inc., Dept. ED, Old Saybrook, Conn.

CIRCLE 136 ON READER-SERVICE CARD FOR MORE INFORMATION

Make
INSTANT CONNECTIONS
without Screws

Use "KLIPTITE" TERMINAL BLOCKS (Molded, Barrier-type) with ANGLED TABS Made for AMP, Self-locking Wire Terminals.

Other terminal blocks available in approved materials range from subminiature (shown) to jumbo (90 amps).

Toggle handle, aircraft type. Bakelite housing. With screw terminals, or solder lugs. DC, or AC up to 1600 cycles. One-hole mounting.

KULKA ELECTRIC MFG. CO., Inc.
Manufacturers of Electrical Wiring Devices
MOUNT VERNON, N. Y.

CIRCLE 137 ON READER-SERVICE CARD FOR MORE INFORMATION

GR
precision-type
Variable Condensers

Very Low Losses
Low Residual Inductance & Resistance
High Mechanical and Thermal Stability
Unique Mechanical & Electrical Design

stator and rotor machined from solid, shaped extrusions of identical aluminum alloy — polystyrene, concentric split-ring insulation — glass polyester shaft — sealed, long-life ball bearings

These condensers are ideal for use in high-quality laboratory instruments and in other circuits requiring a precision-type condenser at moderate price.

Type 1420 Variable Air Capacitors available in three sizes: 70, 130 and 250 μμf maximum capacities. Prices from \$20.00 to \$22.50.

Write for Complete Information

GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Massachusetts

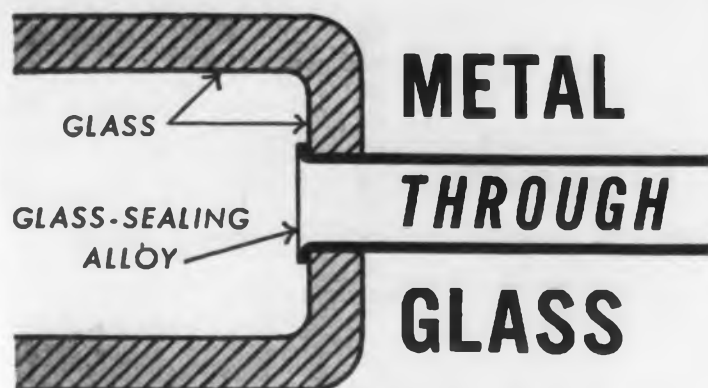
90 West Street NEW YORK 6 • 8055 13th St., Silver Spring, Md. WASHINGTON, D. C.

1150 York Road, Abington, Pa. PHILADELPHIA

920 S. Michigan Ave. CHICAGO 5 • 1000 N. Seward St. LOS ANGELES 38

CIRCLE 138 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • July 15, 1956



Superior Tube offers widest selection of glass sealing alloys

Available for virtually any application. Superior Tube glass sealing alloys are used today to conduct electricity into sealed vacuum or gas-filled chambers. Have same expansion coefficient as glass. Cold drawn to close tolerances in seamless or Weldrawn* form. Sizes from .012 in. to .625 in. Supplied in quantities as small as 50 ft. in any size and analysis. Write for free copy of Catalog 50. Superior Tube Company, 2050 Germantown Ave., Norristown, Pa.

*T.M. Reg. U.S. Pat. Off., Superior Tube Co.

Superior Tube

The big name in small tubing
NORRISTOWN, PA.

Johnson & Hoffman Mfg. Corp., Mineola, N.Y.—an affiliated company making precision metal stampings and deep-drawn parts.

CIRCLE 140 ON READER-SERVICE CARD FOR MORE INFORMATION

**RUGGED!
RELIABLE-
BUILT TO
TAKE IT!**

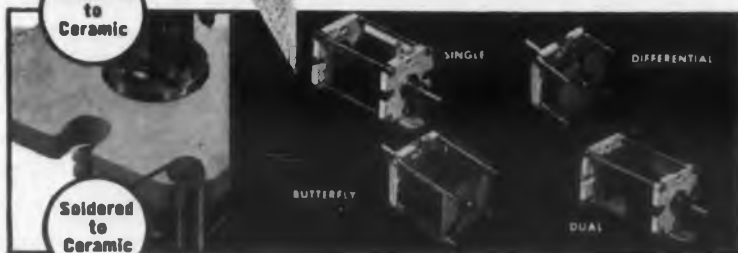
**JOHNSON
"L"
CAPACITORS**

First with true all-solder construction, Johnson Type "L" capacitors are an ideal choice for applications requiring extreme stability and strength. Rotor bearings and stator support rods are actually soldered directly to the heavy 3/8" thick steatite ceramic end frames. Impervious to shock and vibration, parts can't break loose—capacity can't fluctuate. Plate spacing is .030" rated at 1500 volts peak at sea level; over 300 volts at 50,000 feet altitude. Plating is heavy nickel—other platings available on special order. Requires 1 3/4" x 1 3/4" panel mounting area.

• For complete information on Johnson Type "L" Air Variables or other quality Johnson components—write for your copy of Components Catalog 976A.

Soldered to Ceramic

Soldered to Ceramic



E. F. Johnson Company

3413 Second Avenue Southwest • Waseca, Minnesota

CAPACITORS • INDUCTORS • KNOBS • DIALS • SOCKETS • INSULATORS • PLUGS • JACKS • PILOT LIGHTS

CIRCLE 141 ON READER-SERVICE CARD FOR MORE INFORMATION

Servo Valve

Uses Dry Coil Construction



This compact servo valve is designed for stabilization and flight control that permits coil and all magnetic circuitry to operate in air rather than fluid

media. The valve utilizes an isolation diaphragm that functions as a positive fluid barrier. The dry coil torque motor is not immersed in fluid, hence build-up of magnetic particles is prevented.

Five internal micronic filters of corrosion resistant steel furnish thorough filtration of oil within the valve. All oil that passes through the hydraulic amplifier section of the valve must first go through three separate filtering stages.

Integral construction of stainless steel power sleeve, spool, centering springs and null adjustments assure identical coefficient of expansion for excellent null stability under all conditions.

Hydraulic Research and Mfg Co., Dept. ED, 2835 N. Naomi St., Burbank, Calif.

CIRCLE 142 ON READER-SERVICE CARD FOR MORE INFORMATION

Electrical Error Analyzer

For Calibration of Synchros



The Type 226A synchro error test stand is a new and improved precision electrical error analyzer for all sizes of torque or control transmitters, receivers and transformers, 60 or

400cy. Designed for incoming material testing, manufacturing, quality control or laboratory calibration of synchros, the 226A is accurate to ± 10 sec of angle in 10° steps and is in accordance with MIL-S-2335 and MIL-S-16892.

The equipment provides stable indications of the fundamental null and total harmonic null signals in millivolts. A phase shift zero indicator is a function of the fundamental frequency with a resolution of 2sec. Third and higher harmonic signals are attenuated 40db on both 60 and 400cy setups.

Pennsylvania Testing Laboratory, Inc., Dept. ED, Doylestown, Pa.

CIRCLE 143 ON READER-SERVICE CARD FOR MORE INFORMATION



65 types in four stock models

Dependable Ohmite Amrecon general-purpose relays have proven their exceptional ruggedness and long life in years of service. Some models are particularly adapted to applications where severe shock and vibration are present. Others are of the sensitive type. Ohmite can assure you immediate shipment of 65 stock units and good delivery on the many made-to-order relays. Available in current ratings up to 25 amp, AC or DC, with varied contact arrangements; hermetically sealed or dust-protective enclosures.

**HIGH QUALITY,
ALL-PURPOSE RELAYS...
RUGGED, DEPENDABLE
FOR LONG LIFE**



**Current ratings
up to 25 amp, AC or DC**
Also made-to-order models in a wide variety of contact combinations, coil voltages, and contact ratings.

Write on Company Letterhead for Catalog No. R 11.


OHMITE Manufacturing Company

3643 Howard Street, Skokie, Illinois (Suburb of Chicago)

Be Right with **OHMITE**

RHEOSTATS • RESISTORS • RELAYS • TAP SWITCHES

CIRCLE 144 ON READER-SERVICE CARD FOR MORE INFORMATION



WALES "Strippits"
can save up to 60% time,
BOOST PROFITS 25%

... stripping Metal from
conventional Dies the WALES-WAY


● WALES STRIPPITS are
sure tempered springs, held com-
pressed by retainers. Uneven
stripping pressure is eliminated
completely, having constant pres-
sure standard at all points and at
all times and under all conditions.

No more costly delays, remov-
ing dies from the press for re-
pairs. With WALES STRIPPITS,
dies never need be removed nor
dismantled for any repairs. Strip-
per plates easily and quickly re-
moved in the press. The plates
may be half usual thickness or non-existent, as there
is no pressure exerted until the WALES STRIPPITS
go into action.

Save up to 60% man hours and material cost in
die making. Installation is EASY. WALES STRIP-
PITS pay for themselves over and over in time
saved on every job.

Our ENGINEERING SERVICE is for YOU!
We'll be happy to make an analysis of your produc-
tion and give you suggestions as to how WALES
STRIPPITS can supplement your present methods
and INCREASE YOUR PROFITS. No obligation.

NO STRIPPER PLATES USED HERE



This picture shows work
blanked by die, equipped
with WALES STRIPPITS.
Even STRIPPIT pressure
releases work piece in-
stantly.

Send for BULLETIN NO. 20F
Filled with pictures and examples of
WALES STRIPPITS in use. Mailed
to you without cost and by return mail.

WALES Strippit CORPORATION
"...the Wales-Way is the PLUS-PROFIT way"
345 PAYNE AVE. — North Tonawanda, N.Y.
WALES-STRIPPIT OF CANADA LTD., HAMILTON, ONT.

CIRCLE 146 ON READER-SERVICE CARD FOR MORE INFORMATION

Energy Storage Capacitors

Have Low Inductance



Type XN-249 (the unit shown on the photograph) is approx 17" diam x 40" high. The high voltage terminal insulator shown is efficiently utilized to house a portion of the capacitor section. The unit weighs approx 500 lb.

Design of the unit is based on coaxial line principles so as to enable the discharge at rated voltage in an extremely short time. In the case of Type XN-249, the result is a peak current in excess of 200,000amp upon discharge. The unit is completely hermetically sealed.

Applications involve high temperature gas discharge studies and similar applications where extremely high energy bursts are required in an extremely short time. In addition, there are requirements for low inductance capacitors as oscillator tank capacitors in high power r-f generators.

Specifications are: capacitance 0.8 μ f; voltage 100kv with 20% reversal; internal inductance 0.12 μ h max; average Q 200.

Tobe Deutschmann Corp., Dept. ED, Norwood, Mass.

CIRCLE 147 ON READER-SERVICE CARD FOR MORE INFORMATION

1Mc Signal Source

Stable to 1 Part in 10⁹



This instrument offers exceptional frequency stability at a standard frequency of 1Mc. Typical applications include use as a secondary frequency standard, reinsertion

of carrier in suppressed carrier systems, telemetry, navigation systems, geophysics, astronomical and other critical measurements.

Performance characteristics are: frequency: 1Mc tunable over a range of ± 0.5 cy; frequency stability: drift less than 1 part in 10⁹ per day after one month's operation; crystal oven: temperature stabilized to better than 0.01°C by temperature sensitive resistance bridge; outputs; sine wave—4v rms; pulse—1v; output impedance; approx. 250 ohms.

Hycon Eastern, Inc., Dept. ED, 75 Cambridge Pkwy, Cambridge 42, Mass.

CIRCLE 148 ON READER-SERVICE CARD FOR MORE INFORMATION

Write today for

your free copy of this

Technical Paper

ask for data file 705

AC Performance and Phase
Compensation of
Copper-Mandrel Potentiometers

BY BENJAMIN F. LOGAN

*
Research Engineer
Dynamic Analysis & Control Laboratory
Massachusetts Institute of Technology

551



first in precision potentiometers

Helipot Corporation
South Pasadena, California
a division of
Beckman Instruments, Inc.



BECKMAN

CIRCLE 149 ON READER-SERVICE CARD FOR MORE INFORMATION



Got a LOAD on Your mind?

Burdened down with a problem in design

diminution, weight reduction, power capsulation?

lighten the load on your mind; send for the

amazing story of how MPB's* such as these



BALL BEARINGS ACTUAL SIZE

make designing a breeze.

* MINIATURE PRECISION BEARINGS, INC.
7 Precision Park, Keene, N. H.

CIRCLE 150 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • July 15, 1956

Threshold Indicator

For Actuating a Signal Device

The 91296-1 threshold indicator may be used with any of the company's radio interference-field intensity measuring equipments, covering the frequency range of 30cy to 1000Mc.



The instrument is primarily intended to actuate a signalling device, such as a light, bell, or horn, when radio interference exceeds a pre-determined level. This adapts the radio interference measuring equipment for use as a "Go-No-Go" device, for rapid indication wherever interference must not exceed certain levels.

A latching relay and a momentary relay are included in the unit. Operation of the relays may be adjusted to any desired signal level at which the warning device is to be actuated. An impulse counter may also be used with the system for gathering statistical information concerning the number of interference sources checked.

Stoddart Aircraft Radio Co., Inc., Dept. ED, 6644 Santa Monica Blvd., Hollywood 38, Calif.

CIRCLE 152 ON READER-SERVICE CARD FOR MORE INFORMATION

Germanium Rectifiers

100kw Liquid Cooled

This is a 100kw liquid cooled germanium power rectifier capable of delivering 80v d-c at 1350amp with a max input of 66v d-c and approx 1150amp a-c, and with rectifier efficiencies to 98.4%.



This 3-phase full wave bridge rectifier is recommended for a-c to d-c power conversion where high current at moderate voltage output and small unit size is required. The rectifier design provides for superior cooling using a liquid coolant (water, oil, etc.) at a max inlet temperature of 30°C and a flow rate of 4 gals/min (for water).

Unlimited operation life can be expected over a temperature range of -20°C to +50°C max, where equipment is designed to operate within specified voltage, current and temperature rise ratings.

International Rectifier Corp., Dept. ED, El Segundo, Calif.

CIRCLE 153 ON READER-SERVICE CARD FOR MORE INFORMATION



MEMO

FROM: THE ENGINEERING STAFF AT NJE

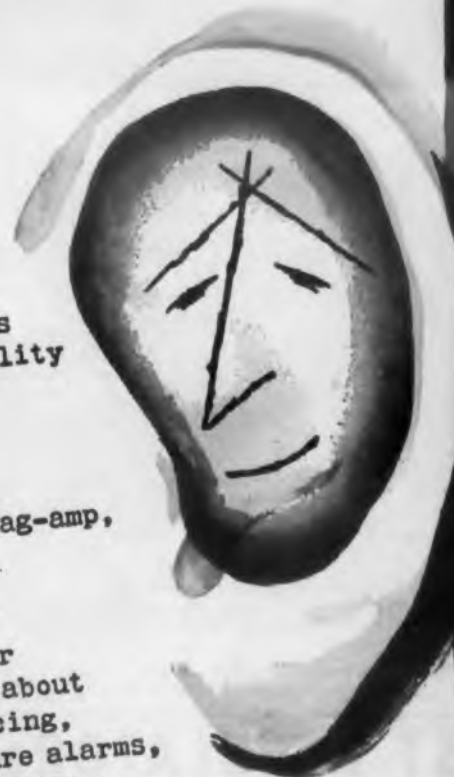
TO: COMPUTER DESIGNERS

SUBJECT: THE SYMPATHETIC EAR

If you are building an electronic computer—digital or analogue—it will pay you to talk to NJE about the power supplies.

Why? Four good reasons:

1. NJE has built computer power supplies for almost every major computer facility during the past two years.
2. NJE offers modern techniques not available elsewhere—ZERO-LAG, ELG SEMI-REGULATED, Transistor-forced Mag-amp, high-speed ET Thyatron, etc.
3. NJE knows computers. We offer the services of engineers with computer design experience. They know all about marginal checking, turn-on sequencing, long-term stability, voltage-failure alarms, fail-safe design, turn-down procedures, heater-cycling, interaction prevention, reliability prediction, and all the rest of modern computer practice.
4. NJE offers the advantages of the world's largest custom power supply volume and the industry's largest, most diversified engineering staff—lower costs, quicker delivery, consistently high quality.



Got computer supply problems?
Tell us.

Ours is a sympathetic—and
experienced—ear.

NJE

corporation

Electronic Equipment & Components

343 CARNEGIE AVENUE, KENILWORTH, NEW JERSEY

Complete Engineering Representation Everywhere

Handle, complete, competitive analysis quotes from
1000 Amps and 1000 Volts to 250 KV line current

P O W E R S U P P L I E S U N L I M I T E D

CIRCLE 154 ON READER-SERVICE CARD FOR MORE INFORMATION

True Hermetic Sealing
assures Maximum Stability in

AMPERITE RELAYS and REGULATORS

Simplest • Most Compact • Most Economical



STANDARD

PROBLEM? Send for
Bulletin No. TR-81

Also — Amperite Differential Relays: Used for auto-
matic overload, under-voltage or under-current protection.

Thermostatic DELAY RELAYS

2 to 180 Seconds



MINIATURE

- Actuated by a heater, they operate on A.C., D.C., or Pulsating Current.

- Hermetically sealed Not affected by altitude, moisture, or other climate changes.

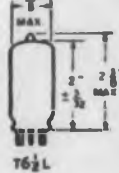
- Circuits: SPST only — normally open or normally closed.

Amperite Thermostatic Delay Relays are compensated for ambient temperature changes from -55°C to $+70^{\circ}\text{C}$. Heaters consume approximately 2 W. and may be operated continuously. The units are most compact, rugged, explosion-proof, long-lived, and — very inexpensive!
TYPES: Standard Radio Octal, and 9-Pin Miniature.

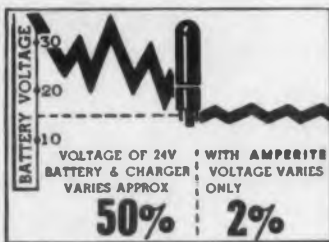
BALLAST REGULATORS

Amperite Regulators are designed to keep the current in a circuit automatically regulated at a definite value (for example, 0.5 amp.)

... For currents of 60 ma. to 5 amps. Operate on A.C. D.C.. Pulsating Current.



Hermetically sealed, they are not affected by changes in altitude, ambient temperature (-55° to $+90^{\circ}\text{C}$), or humidity. Rugged, light, compact, most inexpensive.



Write for 4-page Bulletin No. AB-51

AMPERITE CO., Inc.

561 Broadway, New York 12, N. Y.

Telephone: CAAnal 6-1446

In Canada: Atlas Radio Corp., Ltd.
50 Wingold Ave., Toronto 10, Ont.

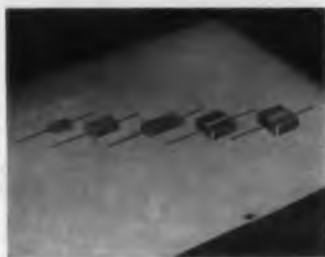


Individual inspection and double-checking assures top quality of Amperite products.

CIRCLE 156 ON READER-SERVICE CARD FOR MORE INFORMATION

Midget Mica Capacitors

High Temperature Molded Units



Two new series of high-temperature molded midget mica-dielectric capacitors have been developed for operation up to 130°C and 160°C without voltage derating.

These capacitors were developed to meet applications in a constantly-increasing variety of high-heat industrial and military equipment. Maximum capacitance is $15,000\mu\text{fd}$ in the 130°C types and $7500\mu\text{fd}$ in the 160°C types. Voltage ratings are 300v and 500v d-c working (depending on capacitance). Temperature ranges are -55°C to 130°C and -55°C to 160°C .

Cornell-Dubilier Electric Corp., Dept. ED, So. Plainfield, N. J.

CIRCLE 157 ON READER-SERVICE CARD FOR MORE INFORMATION

Switches

High Contact Pressure



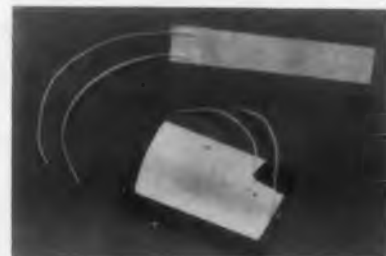
Design features of the series 750 switches are: positive make and break action; high pressure; non-sensitive to vibration and shock; stable against momentary high overload capacity; rugged construction insures long life; oversize fine silver contacts provide stability against momentary high overload capacity; high current capacity enables direct control of circuit.

Controls Corp. of America, Dept. ED, 9555 Soreng Ave., Schiller Park, Ill.

CIRCLE 158 ON READER-SERVICE CARD FOR MORE INFORMATION

Film-Type Heater

Continuous Operation At 600°F



This new electrical resistive film type heater will heat uniformly to a desired temperature over the area covered.

The heating element is lightweight, inorganic, stable, unaffected by environmental conditions or moisture and capable of continuous operation at 600°F . Operation to wattage densities 40w in^2 may be thermostatically controlled.

Thermatic Co., Dept. ED, Box 585, Great Neck, N.Y.

CIRCLE 159 ON READER-SERVICE CARD FOR MORE INFORMATION

A-C Transistor Voltmeter

Has 2uv Sensitivity



Unusual sensitivity of 2uv and battery operation make the Model MV-45A a-c voltmeter a new tool for laboratory use. Minimum battery life is 200 hours, made possible by 9 transistors incorporated in the unit.

Full scale ranges run from 10uv to 1kv in 10db steps, making a total of 17 ranges.

Frequency range is 10cy to 150kc. Accuracy is 2% of full scale on all except the lowest range. Noise level in the MV-45A is well below 500 milli-microvolts over a 100kc pass band. All ranges from 3mv to 1kv have individual calibration controls.

MILLIVAC INSTRUMENT CORP.
444 SECOND STREET
SCHENECTADY 6, N. Y.

CIRCLE 160 ON READER-SERVICE CARD FOR MORE INFORMATION

KNOTS WON'T SLIP

...TIE EASIER AND FASTER
WHEN YOU USE...

**HEMINWAY
& BARTLETT**

NEW!

TEFLON COATED FIBERGLASS TAPES

Newest scientific tapes . . . coated with DuPont Teflon . . . withstand temperatures up to 600° ... fireproof!

NYLON or DACRON Flat Braided Tapes

Meet Gov. Specs Mil-T-14015 Sig. C1 and Fed. 1613 Specially developed in wax, wax free and resin coated finishes

NYLON Lacing Cords comply with ALL construction and finish requirements of Gov. Spec Jan-T-713 and Jan-T-152.

FREE! Write today for free samples.

The Heminway & Bartlett Mfg. Co. ELECTRONICS DIVISION, 500 5th Ave. N. Y. 36 Sales Offices: Chicago, Philadelphia, Boston, Cincinnati, San Francisco, Los Angeles, Detroit, Charlotte, N. C., Gloversville, N. Y., Lynchburg, Va. Foreign Agent: Turner, Halsey Co., Inc., 40 Worth St., N. Y.

CIRCLE 161 ON READER-SERVICE CARD FOR MORE INFORMATION

Brew Delay Lines are

DEPENDABLE

... custom made to meet your most exacting requirements

Brew offers complete design, development and large scale production of delay lines to meet your most critical requirements ... covering an extremely wide range of characteristics ... for both commercial and government applications.

Each line is custom made to exactly satisfy your needs. You get the benefit of continuous research and development and experience on all type lines. Latest packaging techniques, dependable materials, special manufacturing and test procedures assure you of finest quality, ultra compact units with best possible operational characteristics.

Prompt delivery on prototype and production quantities. Catalog 54 gives the complete Brew story. Send for your copy.



Distributed Constant



Lumped Constant



Ultrasonic

BREW

Richard D. Brew and Company, Inc.
Concord, New Hampshire
design development manufacture

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LOOK



in this book...
over 7,000
**STAINLESS STEEL
FASTENINGS**

RIGHT-OFF-THE-SHELF

for immediate delivery

STAINLESS STEEL

- Bolts & Cap Screws
- Socket, Set & Cap
- Nuts, Washers
- Machine Screws
- Sheet Metal Screws
- Wood Screws
- Pipe Fittings
- Dowel, Taper, Cotter Pins
- AN Drilled Fillisters
- Stud Bolts

• Avoid costly production and experimental delays! • Brand new edition of Star Catalog now available.

Write, wire or phone for your copy today!

Stainless Star says "Star's screws have clean, bright-and-shiny heads."



STAR STAINLESS SCREW CO.

663 Union Blvd., Paterson 2, N. J.
Telephone: Little Falls 4-2300
Direct New York phone: Wisconsin 7-9041.

CIRCLE 163 ON READER-SERVICE CARD FOR MORE INFORMATION
ELECTRONIC DESIGN • July 15, 1956

Sampling Switches

5 Minute Brush Replacement



These switches provide constant force brushes, precision phasing 1 to 3 poles, up to 60 shorting or 30 non-shorting channels per pole, complete with 6, 12, or 28v d-c motor, shielded r-f filter, and special precision spur gear reduction.

Plugs are recessed and mounted into housing.

Approximate dimensions as shown are 3.625" sq by 2.687" high. They are also available hermetically sealed or with 400cy a-c motor with slightly changed dimensions.

General Devices Inc., Dept. ED, Princeton, N. J.

CIRCLE 164 ON READER-SERVICE CARD FOR MORE INFORMATION

Miter Gear Boxes

For Right Angle Drives



Type BA precision miter gear boxes are available from stock and have been designed where right angle precision drives are re-

quired. All material is certified under Military applications and is constructed of aluminum (chromic acid anodized) housing and cover and stainless steel ball bearing, shafts and collars. Three size units are available, 1/8", 3/16", and 1/4" shaft size.

PIC Design Corp., Dept. ED, 160 Atlantic Ave., Lynbrook, L. I., N. Y.

CIRCLE 165 ON READER-SERVICE CARD FOR MORE INFORMATION

Solid Tantalum Capacitors

Contain No Liquid Electrolyte



The type STA capacitor contains no liquid electrolyte. Made with a true hermetic seal, the capacitor eliminates altitude and humidity problems. It is intended primarily for low voltage transistor circuits for which it is ideally suited.

Available are 24 standard ratings from 1µfd at 35v d-c working to 350µfd at 2v working. Three standard case sizes are used.

Fansteel Metallurgical Corp., Dept. ED, N. Chicago, Ill.

CIRCLE 166 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW

NATVAR ISOGLAS®

for continuous performance at 150°C.

Natvar Isoglas gives heavy duty equipment extra protection against frequent overloads beyond Class B rating. This glass fabric, coated with a newly developed isocyanate type resin is outstanding in its

- resistance to heat
- resistance to crazing and cracking
- resistance to solvents including the askarels
- toughness and abrasion resistance
- wet dielectric strength
- low temperature flexibility
- fungistatic qualities.

Natvar Isoglas may now be used with great savings where expensive Class M materials were formerly used to solve temperature problems during manufacture of transformers, motors, generators, converters, heavy duty relays, reactors and other types of equipment not requiring a Class M rating.

Technical data and samples are available on request.



Natvar Products

- Slot cell combinations, Aboglas®
- Varnished cambric—cloth and tape
- Varnished canvas and duck
- Varnished silk and special rayon
- Varnished—Silicone coated Fiberglass
- Varnished papers—rope and kraft
- Isoglas® sheet, tape, tubing and sleeving
- Vinyl coated—varnished—lacquered tubing and sleeving
- Extruded vinyl tubing and tape
- Styroflex® flexible polystyrene tape
- Extruded identification markers

Ask for Catalog No. 23

NATVAR CORPORATION

FORMERLY THE NATIONAL VARNISHED PRODUCTS CORPORATION
TELEPHONE: RAHWAY 7-8000 CABLE ADDRESS: NATVAR, RAHWAY, N. J.
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Make More Money
—Improve Your Position



DECISION/INC is retained by leading manufacturers and research firms in all sections of the country. Our clients pay us to find you! No obligation to you—no cost whatsoever. Completely confidential.

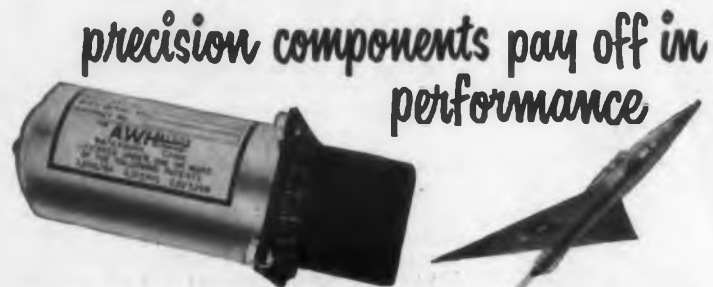
All you have to do is send us your name, type of work, company and home address. We will forward brief forms to your home. We will then present to you various openings in diversified companies from which you can choose the one you like best.

If you would like to know what you're really worth, write, phone or wire us now!

DECISION/INC

Management and Recruitment Consultants
Oliver P. Bardes, President

1422 First National Bank Building
Cincinnati 2, Ohio



THE A. W. HAYDON CO. SPECIAL TIME DELAY RELAY never gives in to severe vibration, shock or sustained acceleration. Positive detent arrangement maintains time setting under all conditions. Large adjusting knob facilitates changing of time setting. Stepless clutch drive minimizes clutch error.

SPECIFICATIONS

- *Voltage Range: 24-29 Volts DC at 68°F.
- Accuracy over Calibrated Range of adjustment:
 - ±0.1 second or ±1% of setting, under condition 1.*
 - ±0.15 second or ±2% of setting, over wide temperature range.
- Meet Military Specs. for temperature, altitude, sand and dust, fungus, salt spray, radio filtering.
- Vibration: 5-55CPS with total excursion 0.060".

Current ratings at 29 Volts and room temperature:

- | | | |
|------------------------------|--------------------------------|-----------------------------------|
| 1. Motor—
25 Milliamperes | 2. Clutch—
200 Milliamperes | 3. Contacts—
1.0 Amp inductive |
|------------------------------|--------------------------------|-----------------------------------|

Time delay period can be adjusted in 2/10 second increments over range of 0.2—30 seconds.

PREFERRED WHERE PERFORMANCE IS PARAMOUNT

The A.W. HAYDON COMPANY
227 NORTH ELM ST. WATERBURY 20, CONN.
Design and Manufacture of Electro-Mechanical Timing Devices

CIRCLE 169 ON READER-SERVICE CARD FOR MORE INFORMATION

Sweep Generator

FM Deviation ±1% to ±20%



Model SG132-2 v-h-f/u-h-f sweep generator offers the following features: center frequency range—15 to 400Mc; c-w, a-m, and f-m output; f-m deviation—±1% to ±20% at any fre-

quency setting; crystal calibration markers—every 200kc, 1Mc, 5Mc, or 20Mc, at an accuracy of ±0.01%; low residual f-m—at 50% amplitude modulation; tuning dial accuracy—±0.05%, without crystal correction; calibrated output—accurate to ±1db; r-f output—0.1 to 150,000μv, when operated into rated load of 50 ohms; power output variation—±0.25db, independent of band or dial setting, type of operation, input power line frequency or voltage variation; harmonic output—less than 40db below desired signal.

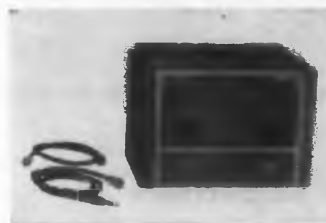
A power-stabilizing circuit maintains constant power output from the r-f oscillator by controlling the oscillator plate voltage as the detected output from the oscillator varies.

Transitron, Inc., Dept. ED, 186 Granite St., Manchester, N. H.

CIRCLE 170 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscilloscope Probe

Also a Video Amplifier



This low-capacitance oscilloscope probe and video amplifier has been designed to extend the utility of oscilloscopes for making accurate observations of waveforms.

The instrument consists of a shielded, low capacitance (1.52μmfd) probe and an associated video amplifier with a gain of 40 to compensate for the probe attenuation.

The overall band-width is within 3db from 5cy to 12Mc. The amplifier may be used separately to provide a gain of 40, or with the probe to provide attenuations of X1, X.1 and X.01.

Used with an oscilloscope, the HF-3A oscilloscope probe permits observation of signals in a circuit with negligible loading or detuning, or otherwise affecting the normal performance of the circuit.

Linear Equipment Laboratories, Inc., Dept. ED, Boonton, N. J.

CIRCLE 171 ON READER-SERVICE CARD FOR MORE INFORMATION



ARNOLD TOROIDAL COIL WINDER

sets up quickly... easy to operate...
takes wide range of wire sizes

SPECIFICATIONS:

- Min. finished hole size: .18 in.
- Max. finished toroid O.D.: 4.0 in.
- Winding speed: 1500 turns/min.
- Wire range: AWG 44 to AWG 26
- Dual, self-checking turns counting system
- Loading (wire length) counter
- Core range: ¼" I.D. to 4" O.D. to 1½" high

LABORATORY USE

- Change wire and core size in 45 sec.

PRODUCTION USE

- 1500 turns per minute
- Insert core and load in 20 sec.

write for literature

ARNOLD MAGNETICS CO.

5962 SMILEY DRIVE, CULVER CITY, CALIFORNIA

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CORNING FIXED GLASS CAPACITORS

available through

ERIE
distributors

Corning Fixed Glass Capacitors provide excellent moisture resistance, high temperature operation, and extremely high reliability in critical applications. These truly miniature capacitors contain only three simple elements: the glass dielectric and case of identical composition; active metal foil plates; and pigtail wire leads. Units conform to Military Specification MIL-C-11272A — and may be obtained through Distributors either certified or Government inspected.

Write to us for Distributor's name
in your locality.

ERIE ELECTRONICS DISTRIBUTOR DIVISION
ERIE RESISTOR CORPORATION
Main Office, ERIE, PA.
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CIRCLE 173 ON READER-SERVICE CARD FOR MORE INFORMATION



new

stainless steel locknuts for temperatures to 800°F.

Fasteners for aircraft electronic applications are being upgraded to meet the special requirements imposed by higher temperatures and unusual climatic conditions. ESNA's solution is a new line of Type 305 stainless steel nuts designed to perform efficiently at temperatures up to 800°F. Silver plating is used to assure a constant locking torque, freedom from galling action and a high degree of re-usability.

This new series is significantly lighter than corrosion resistant fasteners previously available (16% lighter in some sizes . . . in others as much as 63%).

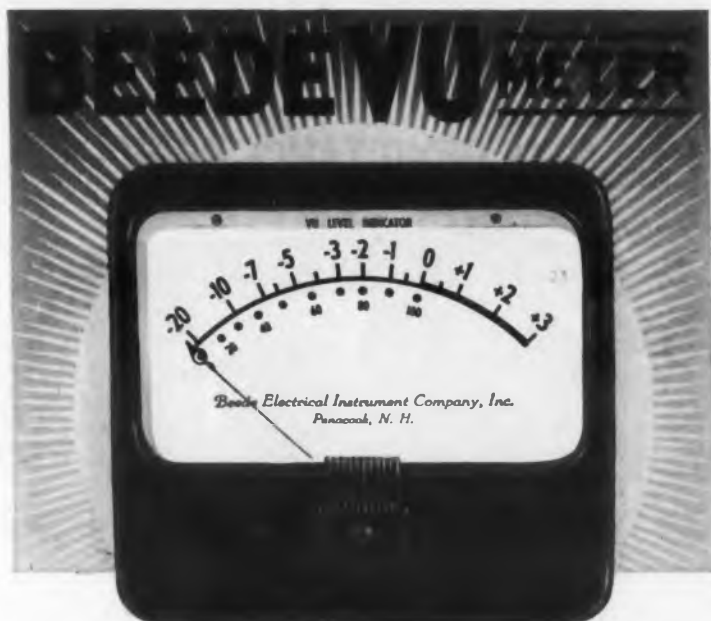
Configurations include one and two lug, fixed and floating type anchor nuts and corner mounting type. Thread sizes are 6-32, 8-32, 10-32 and 1/4-28. For design information, address Dept. N13-757.



ELASTIC STOP NUT CORPORATION OF AMERICA

2330 Vauxhall Road, Union, N. J.

CIRCLE 174 ON READER-SERVICE CARD FOR MORE INFORMATION



IN THE NORMAL EXPANSION AND DEVELOPMENT OF THE BEEDE INSTRUMENT LINE THE **VU** METER BECOMES ANOTHER PROMINENT MEMBER. THE MOST POPULAR MODEL IS IN THE **16** STYLE.

*Inquiries as to modifications of
this meter are always welcome*

BEEDE ELECTRICAL INSTRUMENT CO., INC.
PENACOOK, N. H.

CIRCLE 175 ON READER-SERVICE CARD FOR MORE INFORMATION

Wide Band Amplifier Has High Amplification



The Model 380 combines a wide pass band with high amplification, having 70db gain over the frequency range from 2kc to 60Mc. Input and output impedances are 90 ohms, and the unit is supplied with self-contained power supply in an instru-

ment case 8-1/2" x 10-1/2" x 12-3/4". A front panel gain control is provided.

Applications include pulse amplification, pre-amplification for counters to increase their sensitivity, and use as a general laboratory amplifier within its frequency range.

Instruments for Industry, Inc., Dept. ED, 150 Glen Cove Rd., Mineola, N. Y.

CIRCLE 176 ON READER-SERVICE CARD FOR MORE INFORMATION

In-Circuit Tester

Cuts Capacitor Service Time 75%



This new in-circuit tester cuts capacitor service time as much as 75%. The unit is capable of locating 7 out of 10 faulty capacitors without removing them from circuit.

Capable of testing both shunted and coupling capacitors, the 383-A Capacohmeter has an efficiency rating 10 times greater than conventional in-circuit shunt testers. In the case of faulty coupling capacitors, over 90% of faulty

capacitors can be detected. The unit is equally efficient on color and on black and white TV.

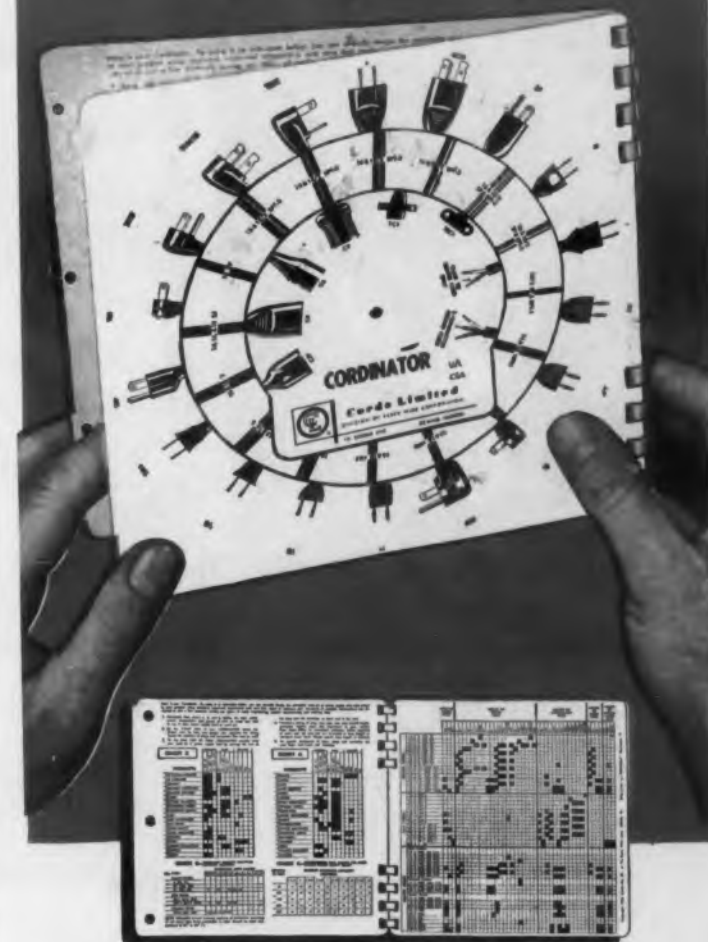
Weighing only 9 lb, the Capacohmeter can be used with paper, mica, and ceramic capacitors. Capacitance is indicated directly on the meter scale over a range of 10µµfd to 10µfd. A considerable number of capacitance values can be measured in-circuit. All can be measured out-of-circuit.

Simpson Electric Co., Dept. ED, 5200 W. Kinzie St., Chicago, Ill.

CIRCLE 177 ON READER-SERVICE CARD FOR MORE INFORMATION

NOW!

DESIGN NEW CORD SETS
and
POWER SUPPLY CORDS
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Cordinator



THIS new tool for purchasing agents and designers permits actual visual fabrication of hundreds of cord sets and power supply cords . . . at your desk . . . in a few short moments.

Simplified charts give quick selection of approved wire for your specific product . . . and all Cords, Ltd. types of standard plugs and connectors that are best adapted to it. The dial side of the Cordinator then permits visual construction of the Cord Set you have selected.

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ask your Purchasing Department to send for this cost-reduction tool.



CORD SETS

CORDS LIMITED

DIVISION ESSEX WIRE CORPORATION
121 DODGE STREET, DEKALB, ILLINOIS

CIRCLE 178 ON READER-SERVICE CARD FOR MORE INFORMATION

Send for this new booklet of facts
and figures on

TAP-LOK[®] INSERTS



Nominal Size	Suggested Tap		Suggested Die	
	Tap	Die	Tap	Die
1/8"	1/8" NPT	1/8" NPT	1/8" NPT	1/8" NPT
1/4"	1/4" NPT	1/4" NPT	1/4" NPT	1/4" NPT
3/8"	3/8" NPT	3/8" NPT	3/8" NPT	3/8" NPT
1/2"	1/2" NPT	1/2" NPT	1/2" NPT	1/2" NPT
5/8"	5/8" NPT	5/8" NPT	5/8" NPT	5/8" NPT
3/4"	3/4" NPT	3/4" NPT	3/4" NPT	3/4" NPT
7/8"	7/8" NPT	7/8" NPT	7/8" NPT	7/8" NPT
1"	1" NPT	1" NPT	1" NPT	1" NPT
1 1/8"	1 1/8" NPT	1 1/8" NPT	1 1/8" NPT	1 1/8" NPT
1 1/4"	1 1/4" NPT	1 1/4" NPT	1 1/4" NPT	1 1/4" NPT
1 3/8"	1 3/8" NPT	1 3/8" NPT	1 3/8" NPT	1 3/8" NPT
1 1/2"	1 1/2" NPT	1 1/2" NPT	1 1/2" NPT	1 1/2" NPT
1 3/4"	1 3/4" NPT	1 3/4" NPT	1 3/4" NPT	1 3/4" NPT
2"	2" NPT	2" NPT	2" NPT	2" NPT
2 1/4"	2 1/4" NPT	2 1/4" NPT	2 1/4" NPT	2 1/4" NPT
2 3/4"	2 3/4" NPT	2 3/4" NPT	2 3/4" NPT	2 3/4" NPT
3"	3" NPT	3" NPT	3" NPT	3" NPT
3 1/2"	3 1/2" NPT	3 1/2" NPT	3 1/2" NPT	3 1/2" NPT
4"	4" NPT	4" NPT	4" NPT	4" NPT
4 1/2"	4 1/2" NPT	4 1/2" NPT	4 1/2" NPT	4 1/2" NPT
5"	5" NPT	5" NPT	5" NPT	5" NPT
5 1/2"	5 1/2" NPT	5 1/2" NPT	5 1/2" NPT	5 1/2" NPT
6"	6" NPT	6" NPT	6" NPT	6" NPT

Here is a new guide to strong, wear-resistant tapped threads in non-ferrous metals, plastics and other structural materials . . . through the use of TAP-LOK INSERTS.

You'll find detailed information . . . illustrations, typical applications, specifications . . . on these internally and externally threaded bushings of steel or brass which increase shear area in one self-tapping operation.

Write for your free copy today.



Also manufacturers of Groov-Pins for positive locking press fit.

GROOV-PIN CORPORATION

1125 Hendricks Causeway

Ridgefield, New Jersey

CIRCLE 179 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature

Frequency Meters 180

Short form catalog C-702 has been released describing the company's 7000 series of time interval meters and frequency meters. Included are descriptions, applications, illustrations of the several units, and brief specifications.

Berkeley Div., Beckman Instruments, Inc., 2200 Wright Ave., Richmond 3, Calif.

Counter Tubes 182

A new 4-page brochure has been issued describing ratemeters for measurement of radioactivity. Illustrations of the major types of halogen quenched, stainless steel counter tubes are listed. Prices of this product are also included.

Anton Electronics Labs., Inc., 1226 Flushing Ave., Brooklyn 37, N.Y.

Ultrasonic Delay Lines 181

A new bulletin, No. 48, has been offered covering a complete line of solid ultrasonic delay lines. Included are general information, construction and operation, performance graphs, line illustrations, and typical measurement diagrams.

Bliley Electric Co., Union Station Bldg., Erie, Pa.

Rivets 183

A 14-page data book has been offered describing Rivnuts, a one-piece blind rivet with internal threads. Included are a description of how they work, preparation procedures, illustrations, tables showing the various types with sizes and type numbers, test data, and torque strength data. The B. F. Goodrich Co., Akron, Ohio.

CINTEL MUTUAL and SELF INDUCTANCE BRIDGE

Coverage:
0.001 μ H to 30mH in 12 ranges
100 μ Ω to 3000 Ω

Accuracy:
 $\pm 1\%$ of full scale on all ranges

Frequency:
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Price:
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Features:

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- Maintains accuracy at low values.
- L & R balances are independent.
- Built in oscillator and visual detector.



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CINTEL bridges simplify intricate measurements and all have wide range and high accuracy. Watch for future ads. Detailed specification on request.

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MARCONI Instruments 44 New Street • New York 4

CIRCLE 184 ON READER-SERVIC CARD FOR MORE INFORMATION

Chemicals For Industry 189

A booklet has been published describing chemicals for industry. Included in the booklet are salts, acids, and oxides of molybdenum, uranium, vanadium, and tungsten.

The S. W. Shattuck Chemical Co., 1805 S. Bannock St., Denver 23, Colo.

Antenna Accessories 190

A new catalog, No. 257, has been issued describing more than 40 standard accessory items used in electronic and TV installations and service practice. The catalog includes photographs, diagrams, and features single as well as multi-installations.

Javex, P.O. Box 646, Redlands, Calif.

Airborne Power Supply 191

A new bulletin has been issued describing airborne high voltage radar power supplies and more specifically, a 6000v model. Specifications of the 6kv unit are outlined, and advantages of the use of these power supplies is discussed.

Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.

Scintillation Detectors 192

The latest issue of "the Nucleus" describes a new line of radioactivity detecting scintillation counters. These detectors are designed for use with radioactive isotopes in medical, biochemical, industrial, and physical research.

Nuclear Instrument and Chemical Corp., 229 W. Erie St., Chicago, Ill.

VTVM 193

A technical bulletin has been made available on the Model 204 low frequency VTVM. Included are features of the instrument, a general description, and complete specifications.

Shasta Div., Beckman Instruments, Inc., Richmond, Calif.

Reflecting Galvanometers 194

A brochure has been made available describing a line of reflecting galvanometers. Included in the brochure are descriptions, applications, features, and specifications of the various types illustrated.

Pimex Inc., 2 E. 82nd St., New York 28, N. Y.

When circuit conditions
require a tube with higher
amplification factor, specify -

Chatham Type 5998

IMPROVED
**TWIN POWER
TRIODE**

- for voltage regulation!



Similar to popular CHATHAM Types 6AS7G and 6080 Twin Power Triodes but offers a higher amplification factor. Characteristics include very low microphonics, improved triode balance and reduction of plate current drift.

ELECTRICAL DATA

Mu	5.5
Transconductance	14,000 micromhos
Plate Dissipation	13 watts per plate

FOR COMPLETE INFORMATION - call or write for the illustrated data bulletins.



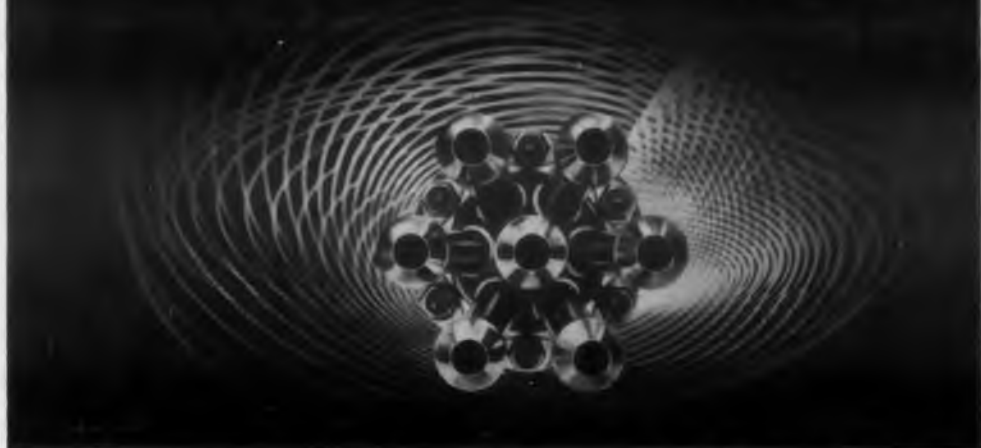
CHATHAM ELECTRONICS

Division of Gera Corporation - LIVINGSTON, NEW JERSEY

CIRCLE 195 ON READER-SERVICE CARD FOR MORE INFORMATION

Engineers

choose your climate...choose your job



AiResearch jet pump "shoots air bullets" to increase efficiency of refrigeration units

THE GARRETT CORPORATION

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Aero Engineering Division, Mineola, Long Island, New York

AiResearch Manufacturing Co. of Arizona, Phoenix, Arizona

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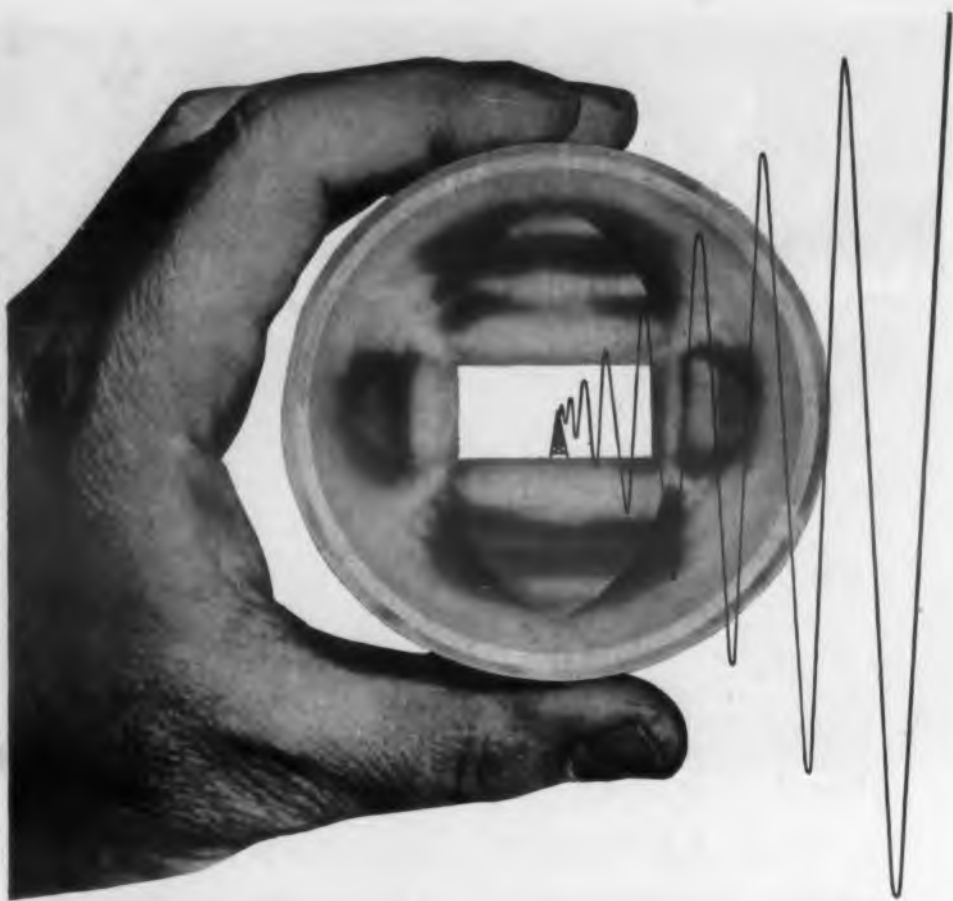
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CIRCLE 199 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supplies

200

Six-page bulletin S-56 has been offered on power supplies. The new bulletin has complete specification listings on all the company's standard tubeless magnetic amplifier regulated 6, 12, 28, and 115v d-c power supplies, as well as airborne radar power supplies, a-c line voltage regulators and heavy duty germanium rectifier units. Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.

Limiters and Fuses

202

A new 10-page catalog has been offered presenting detailed data on this company's line of small dimension limiters and fuses for use in aircraft, instrumentation, electrical, electronic and automotive industries. The range of fuses covers physical sizes from 1/4" x 5/8" to 13/16" x 10", in ratings up to 10,000v. Sightmaster Corp., 111 Cedar St., New Rochelle, N. Y.

Subminiature Rotary Switch

201

An engineering data sheet describes completely the new series 7000 12-position subminiature rotary switch. Providing 12 stator positions per deck exclusive of poles, the series 7000 is only 1.160" diam including contacts. These switches provide unusual versatility and variability; standard contact arrangements from 1 pole/12 positions to 4 poles/3 positions per deck are offered. All electrical characteristics, details of construction, listings of available models, specifications, and mounting dimensions are covered in the data sheets.

International Instruments Inc., P.O. Box 2954, New Haven, Conn.

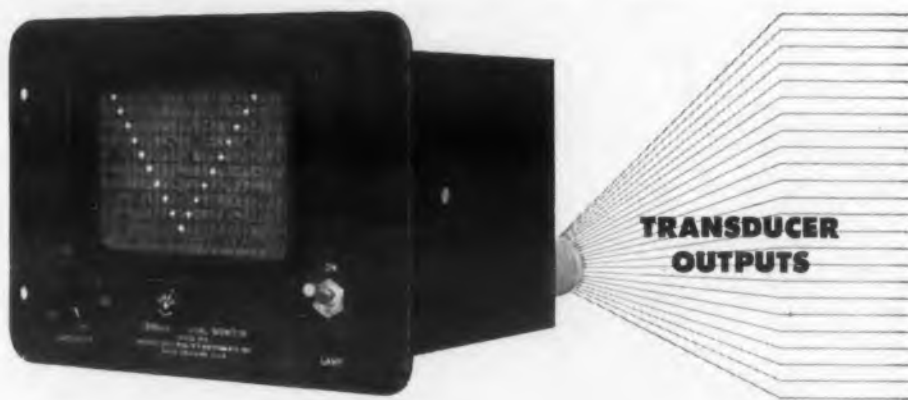
Silicone Impregnating Varnish

203

An 8-page data sheet has been issued describing the uses, properties, and application procedures of R-620 silicone impregnating varnish for high-temperature electrical insulation systems. It is outstanding for its ease of application, bubble-free curing, and hard, tack-free cured surface, which remains free from dust accumulation and chemical attack. R-620 meets or exceeds the high-temperature requirements established by the U.S. Navy, the AIEE (Class H) and the NEMA Group III standards.

Union Carbide & Carbon Corp., Silicones Div., 30 E. 42nd St., N.Y. 17, N.Y.

Century MODEL 20 VISUAL MONITOR



For TEMPERATURE PRESSURE VIBRATION FLOW RADIATION COLORIMETRY CURRENT VOLTAGE

Does your data problem include any of the above? Or anything similar?

The Model 20 Visual Monitor is a completely new concept in multiple data-point indication.

Now you can observe and measure 24 separate data points, simultaneously. No Switching, no commutating, no time lag.

Wherever a graphic display of several quantities will facilitate measurement and control, the Model 20 should be considered.

Utilizing light-beam D'Arsonval galvanometers as the indicating elements, the Visual Monitor permits display of transducer output in an easy-to-interpret, graphic form.

Let us hear from you. We would like to discuss your instrumentation problems with you.

Century Electronics & Instruments, Inc.
1333 No. Utica, Tulsa, Oklahoma

CIRCLE 204 ON READER-SERVICE CARD FOR MORE INFORMATION

Beryllium Copper Springs 209

A new 4-page technical bulletin has been made available describing the uses and advantages of beryllium copper as the heart of a new vibration damping device for mounting electronic components in aircraft. Included are complete data on metal requirements for the Berylco alloy wire mesh springs, as well as design and fabrication considerations.

The Beryllium Corp., Reading, Pa.

Vibration Case Histories 210

Eighteen case histories which are typical of installation problems that prevent full utilization of machine tools for increase production are described in a new folder now available. The selected cases are taken from experiences of 42 machine tool builders who used the company's mounts. Case histories reported include mounting of several types of milling machines, a turret punch press, a precision gear grinder, a power shear, several types of surface grinders, and diversified punch presses.

Barry Controls Inc., 700 Pleasant St., Waverlytown, Mass.

X-Ray Spectrograph 211

A new 2-page bulletin has been issued telling how Shell Oil utilizes the X-ray Spectrograph for production control at its Martinez Refinery. The text deals with additives and tetra ethyl lead determinations and describes how the new method provides required accuracy and is much faster and less costly than wet methods.

Instruments Div., North American Philips Co., Inc. 750 So. Fulton Ave., Mount Vernon, N.Y.

Stainless Steel Tubing 212

A reissued 12-page catalog has been made available describing cold drawn mechanical, capillary, hypodermic, nickel and nickel alloy tubing, to replace the 8-page catalog, #11, published in 1955. The catalog describes the line ranging in size from 0.008" to 1.000" OD with 0.003" to 0.083" wall, as well as the tubular fabricated parts. Data is included on comparative analysis of alloy types, specifications, standard tolerances, physical properties and relative workability. J. Bishop & Co., Platinum Works, Stainless Steel Products Div., Malvern, Pa.



Harnesses...
Cable Assemblies...
Cord Sets...

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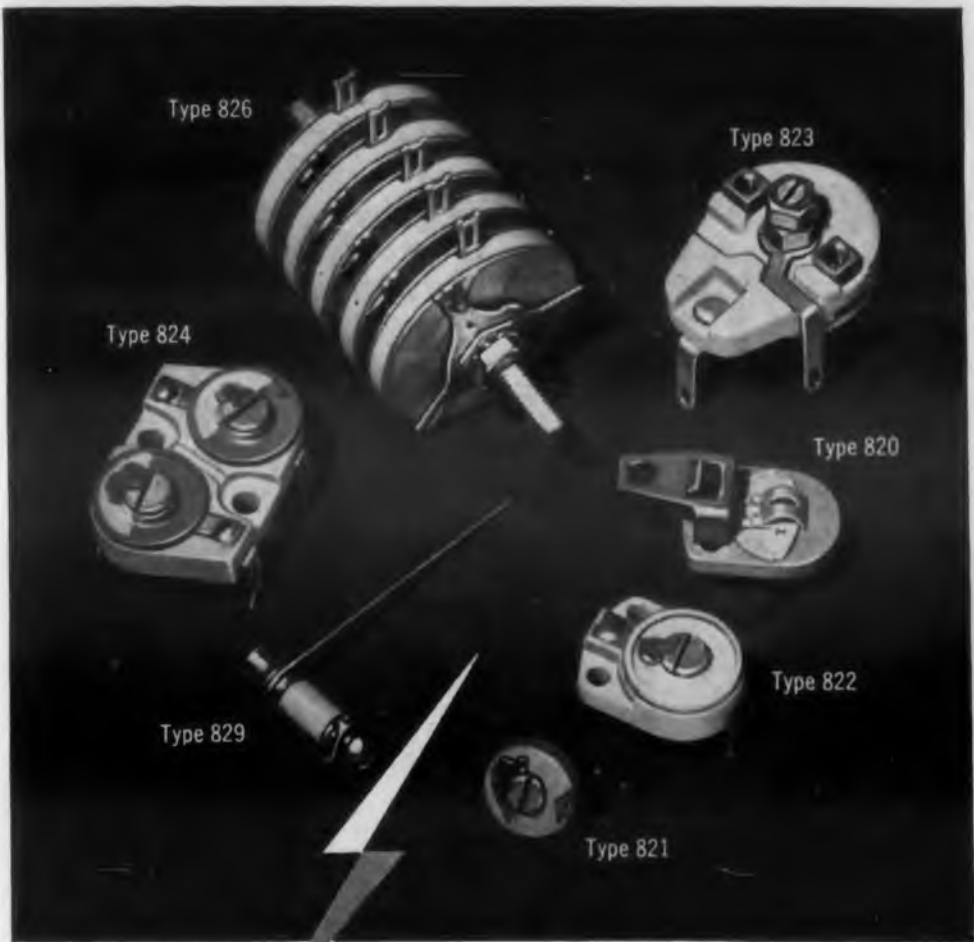
We are equipped to manufacture any of the following:

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The most complete line of Ceramic Trimmer Capacitors




Eight standard types. Special designs engineered to specifications.

All units rated 600 V. D. C. W., 1500 V. D. C. test

Capacity range from .5 to 125 mmf.

Small size—light weight

Power factor less than 0.2% at one megacycle

-  Rotors and stators ground optically flat, to insure dependability and accurate retrace.
-  Lightweight rotors always in balance and under heavy spring pressure. Provide excellent stability under vibration without special locking device.
-  All units easily adjusted. Full capacity range is obtained with 180° rotation. Equal stability is maintained at any position from minimum to maximum.

For further information, write for Technical Bulletin 42-101R1.

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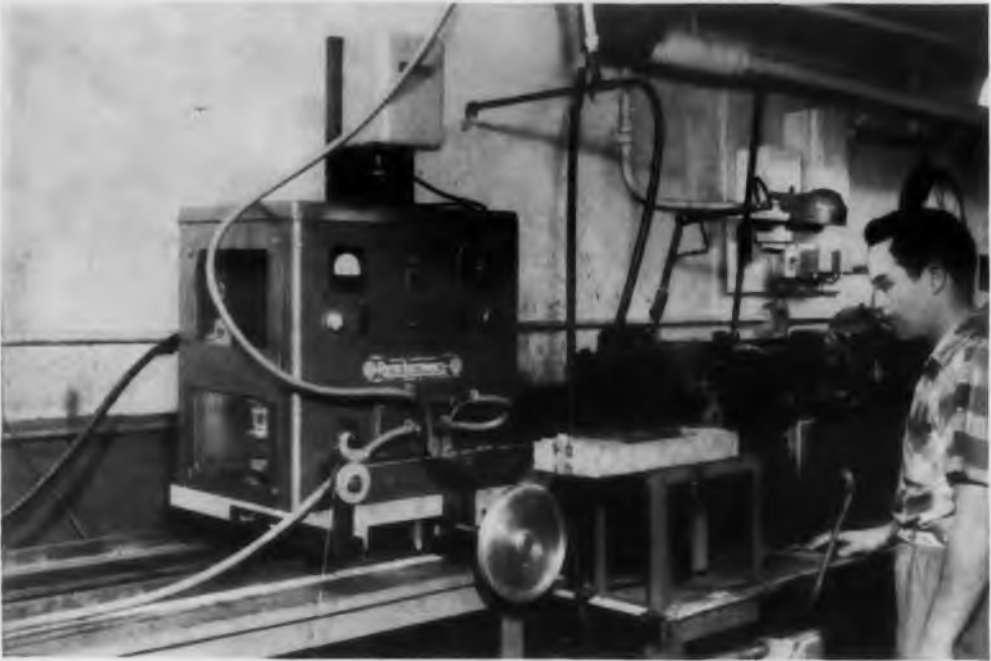


CIRCLE 214 ON READER-SERVICE CARD FOR MORE INFORMATION

\$20,000 IN SALES SAVED

by a
**CHICAGO STANDARD
STOCK
TRANSFORMER**

For Reeve Electronics, Inc.,
of Chicago, Illinois



Reeve manufactures custom-made, high frequency heating equipment, including a device to eliminate hand retwisting and retraining of cut standard wire. It applies a high frequency pulse to the point at which the wire is to be cut, forming a solid bundle of the wire strands that resists the strain of cutting and stripping.

Normally sold individually, Reeve received orders for fourteen of these units—all with firm delivery dates within a five week period. All parts could be obtained in time, except for one special choke. This stumbling block was removed, however . . . when they found that Chicago Standard Transformer C-1414 met the required specifications . . . and was *immediately available from stock*.

RESULT:

Reeve was able to meet their customers' delivery deadlines. This would have been impossible if they had to wait for the production of a "special" transformer.

**LET CHICAGO STANDARD
STOCK TRANSFORMERS
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431 Greenwich St., New York 13, N. Y.

CIRCLE 219 ON READER-SERVICE CARD FOR MORE INFORMATION

Phase Comparator

220

A new 6-page illustrated folder has been made available describing the Model 201 phase comparator. It covers the operation and applications of this model, which has been specifically designed for computer, control and servomechanisms testing where phase relationship must be accurately determined. Specifications and advantages of the equipment are listed in the folder.

Link Aviation, Inc., Binghamton, N.Y.

Alloys

221

Four bulletins have been published describing four new product developments of interest to electrical, electronic, and instrument manufacturers. Each of these pamphlets include information on (1) 0.0005" diameter enameled Karma wire with specifications; (2) D-H alloy #531, describing temperature resistance characteristics; (3) heating element alloy #245, designed to make possible a longer life heating element; (4) D-H thermocouple alloys #242 and #33. Included in this pamphlet is a temperature curve showing the EMF temperature relationships and tables illustrating thermocouple stability in reducing temperature. Driver-Harris Co., Harrison, N.J.

Titrometer

222

Bulletin 640B has been published describing the company's dual recordmatic titrometer. In addition to the applications of the unit, the bulletin discusses such features as wide range, automatic plotting of titration curves and control of titrant feed rate, simplified operation, and sturdy construction.

Precision Scientific Co., 3737 W. Cortland St., Chicago, Ill.

Automatic Transfer Switch

223

A 4-page illustrated bulletin has been released covering circuitry and mechanical features of the Trans-O-Matic automatic transfer switch. The bulletin describes the use of two circuit breakers with a motor-driven mechanical linkage to provide positive transfer of service for power and light to an emergency source in event of failure of the normal source. Schematic drawings show four optional transfer circuits. Also covered are available accessories including special enclosures, adjustable time delay on restoration, engine starting contacts, pilot lights and several others.

Lake Shore Electric Corp., 205 Willis St., Bedford, Ohio.

**Portable...
Versatile...
Temperature
Test Chamber**

For ambient temperature tests in the **LABORATORY** or on the **PRODUCTION LINE**, the Model TC-2 Temperature Test Chamber is ideal. Interchangeable extra test trays may be ordered to eliminate loading delays in continuous production tests, or for convenience in special test work.

Range: -65° to +350° F.
Heater: Electric strip heater
Coolant: Dry ice, 15 lbs. capacity
Control: Adjustable thermostat & selectable heat inputs
Load Capacity: 600 cubic inches of test materials
Power: 115V, 5 amp. 50-60 cycle
Overall Size: 48" x 16½" x 12"
Weight: 62½ lbs.



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TEMPERATURE
TEST CHAMBER**

\$550.00
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**STATHAM
DEVELOPMENT
CORPORATION**

12411 W. Olympic Blvd.
Los Angeles 64, Calif.

CIRCLE 224 ON READER-SERVICE CARD FOR MORE INFORMATION

Microwave Components 229

A new 12-page catalog, C-536, has been issued describing in detail the complete line of E and H plane bends and top wall and side wall hybrid junctions now available from this company. Included are illustrations, specifications, dimensional drawings. Microwave Development Laboratories, 92 Broad St., Wellesley, Mass.

Metal Marking Machines 230

A 50th Anniversary catalog has been published containing the complete line with hundreds of illustrations of marking applications. The 3-color printed catalog includes basic technical information on metal marking, rapid production marking machines, series 50 general purpose marking machines, precision graduating equipment, mechanical and pneumatic marking presses, bench marking machines and several others. Also included are new marking machines capable of production speeds up to 15,000 pieces per hour with full automation, and the cyclomatic control for cycling and sequencing marking machine operations. Noble & Westbrook Mfg. Co., Westbrook St., E., Hartford 8, Conn.

Wound Cores 231

A new and comprehensive 32-page bulletin has been issued covering an extensive line of wound cores. The booklet, titled Orthosil Wound Cores, provides a complete parts list of standard 4 mil and 12 mil "C" cores and toroidal cores. Included are mechanical dimensions, tolerances and weights. Thomas & Skinner, Inc., 1157 E. 23rd St., Indianapolis, Ind.

Aluminum Nameplates 232

A 3-color, 4-page brochure has been issued describing Therma-Cal all-purpose aluminum nameplates for use on irregular surfaces and crinkle finishes. In addition, this illustrated booklet shows typical applications: dials, scales, insignia and trade-schematic drawings, insignia and trademarks which can be permanently color-anodized and etched into the surface of thin-sheet aluminum. One page of the booklet is a catalog sheet describing accessories which can be obtained by Therma-Cal users—including photos, descriptions, and prices. North Shore Nameplate Co., 214 Northern Blvd., Bayside, L.I., N.Y.

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We offer you work on challenging new projects in various stages of research and development. We offer you stimulating professional problems, top pay levels and working conditions, and ideal family living in semi-rural Westchester—just an hour from New York City.

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PRECISION

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Patents

John Montstream

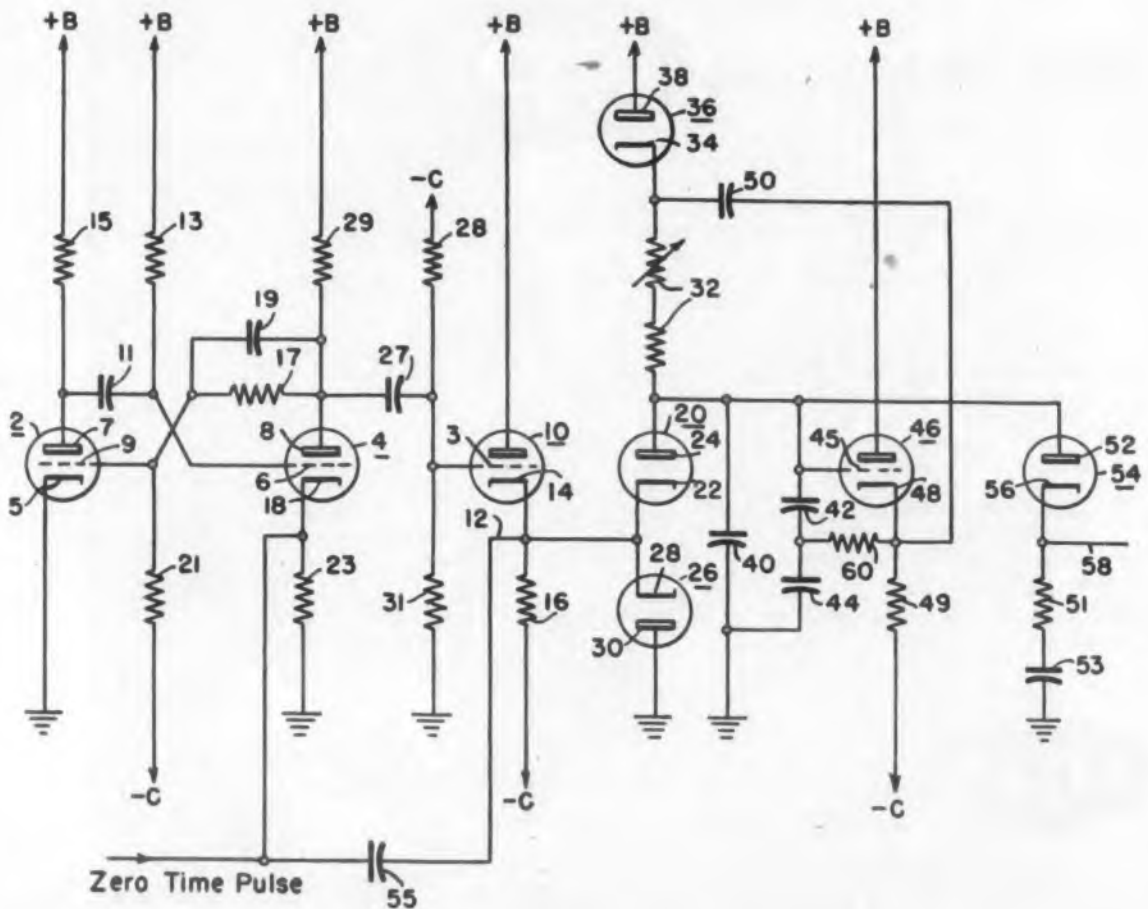
Sawtooth Generator . . . Patent No. 2,727,144. W. L. Leyde and David R. Houston. (Assigned to Westinghouse Electric Corp.)

Sawtooth generators as a rule do not provide an exactly linear wave in that the wave does not start at zero volts and variations in temperatures affect the linearity of the wave. With the generator described in this patent these undesired characteristics are eliminated or minimized and, in addition, the sawtooth wave is generated at zero time upon application of the starting pulse.

The circuit includes an oscillator consisting of tubes 2 and 4 and their circuit elements for generating a gating pulse for discontinuing the generation of the sawtooth wave. The gating pulse from the oscillator is amplified by tube 10 and ap-

plied to the cathodes of diodes 20 and 26. The cathodes of these diodes are connected. Normally, the two diodes are conducting.

Upon application of the initiating zero time pulse to the oscillator and to the cathodes of diodes 20 and 26, current through diode 20 is cut off. So long as diode 20 is passing current, capacitors 40, 42 and 44 are not charged. With diode 20 cut off, the charging current passes through diode 36 and charging resistors 32. Charging of the capacitors causes the bias on grid 45 of amplifier tube 46 to rise, so that the cathode potential of this tube increases as charging progresses. The potential of cathode 48 is applied to the cathode of diode 36. As the potential on the lower end of resistors 32 increases, the potential at cathode 34 or the upper end of the charging resistors



also increases. A substantially constant potential is maintained then across the charging resistors 32 and linearity of the sawtooth wave is maintained for about 70% of its potential increase. By connecting resistor 60 between the cathode of the tube 46 to the connected plates of capacitors 42 and 44, compensation is provided for the circuit, so that the linearity of the sawtooth wave is maintained for 90% of its potential increase. The oscillator gating pulse restores diode 20 to its conducting state and charging of the capacitors ceases. The output of the circuit is taken from cathode connection 58 of tube 46.

Charging capacitors 40, 42 and 44 are temperature compensated by capacitor 40 having a negative temperature coefficient and capacitors 42 and 44 having a positive temperature coefficient. In this way any change in the temperature which may affect the capacitors is compensated for. Preferably, too, the charging resistors are wire wound so that they maintain their resistance substantially constant over the operating range of the circuit. The circuit generates a sawtooth wave of good linearity which begins at zero time and at zero potential and is temperature compensated.

Frequency Control . . . Patent No. 2,738,422. Leslie L. Koros. (Assigned to Radio Corp. of America.)

A frequency control system for a magnetron operating in the microwave frequency spectrum. A stable electronic oscillator operating at a submultiple of the magnetron frequency is appropriately coupled to the output of the magnetron. The coupling is such as to synchronize the magnetron frequency to the frequency of the stable oscillator.

Deflected Beam Tube Binary Adder . . . Patent No. 2,735,936. Darrin H. Gridley, Washington, D. C.

An electron tube with two beams and appropriate deflection plates for controlling the position of the beams. By utilizing two collector plates for each beam and applying feedback from a collector of each beam to a deflection plate for the other beam, it is possible to build a bistable device with two stable beam positions. To change the state of the device it is only necessary to apply an external voltage to another deflection plate, thereby moving the beams to the other stable state.



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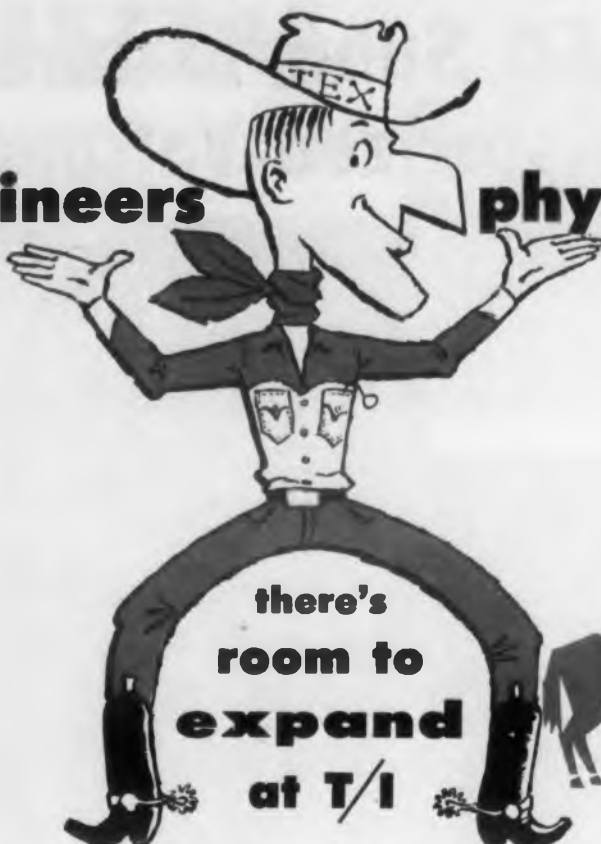
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Cold Cathode Switch Tube . . . Patent No. 2,729,762. G. E. Hagen, C. R. Williams and R. D. Hancock. (Assigned to Northrop Aviation, Inc.)

The cold cathode tubes used in flip-flop circuits have limitations in the speed of operation which is determined by the deionization time of the gas content of the tube. If this time is reduced, the counting rate of a flip-flop circuit can be increased with accuracy in the count. In addition, a tube with higher sensitivity and having a voltage swing which is greater has its advantages.

This patent describes a tube with these improvements by providing an anode symmetrically located between a pair of cathodes and a tube filling. The tube is of a gas such as helium containing from one to five per cent of water vapor or hydrogen or mixtures of both.

Power Amplifier Tuning and Loading Device . . . Patent No. 2,738,471. Russell J. Cassutt. (Assigned to Collins Radio Co., Cedar Rapids, Iowa)

A variable inductor for high power applications which utilizes a coil form mounted

on bearings. The coil is wound around this form and makes electrical contact through roller brushes which move along the coil as the form is rotated. By rotating the coil form it is possible to vary the effective number of turns and thus the inductance of the coil.

Mixer Circuits . . . Patent No. 2,726,326. R. I. Bowen. (Assigned to Raytheon Manufacturing Co., Waltham, Mass.)

This patent describes a triode-heptode mixer circuit in which a substantial increase in the conversion gain is secured.

The input signal is applied to grid 17 of the heptode section. Local oscillator 1 applies its frequency to the first grid of the heptode section, which is continuous with the control grid of the triode section. Plate 35 of the triode is connected with screen grid 16, 18 of the heptode; thus it is connected with the same source of d-c potential that is applied to these screen grids. Bypass capacitor 22 keeps the screen grids and plate 35 at ground potential so far as radio frequencies are concerned. Plate 20 of the heptode receives its potential through inductance 31, which has a capacitor 32 in parallel with it, so that the plate circuit



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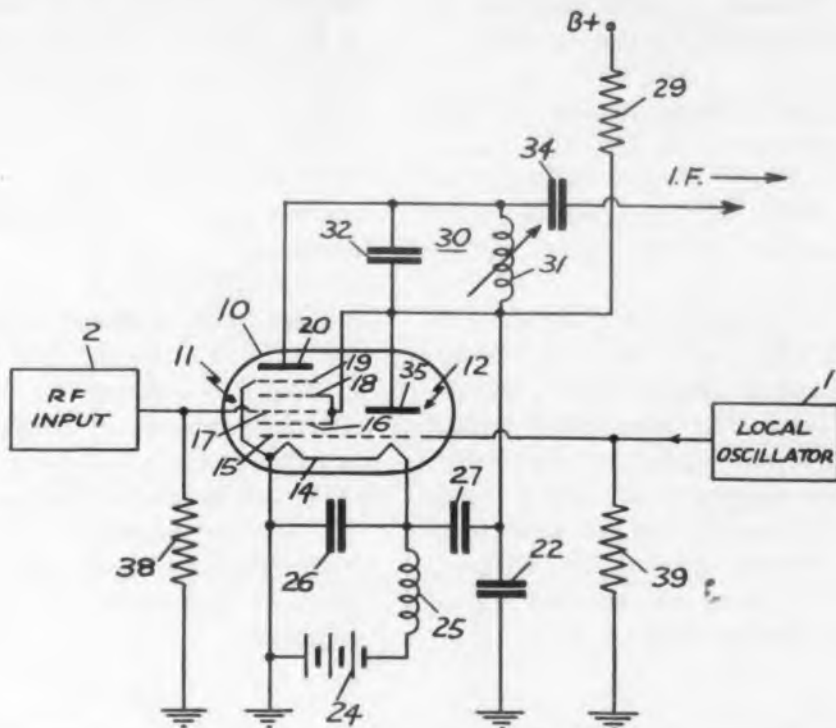


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can be tuned to the i-f output of the circuit.

The heptode section of the tube need not be a 5-grid section but may have as many grids as desired. The only requirement is that input grid 17 be well shielded from the grid of the triode section. Since a common grid for both tube sections has the local

oscillations applied to it, the electron stream in the heptode is modulated by both the local oscillation and the input frequency, resulting in an i-f output. By maintaining plate 35 of the triode section of the mixer circuit positive with respect to its cathode, the circuit secures a substantially increased gain in frequency conversion.



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Means for Changing Coupling Impedance
... Patent No. 2,735,902. Aubrey W. Vose.
(Assigned to The Houston Corp., Los Angeles, Calif.)

A means for changing the loading on a tuned circuit and thereby changing the Q of the circuit. By applying a bias to a crystal diode it is possible to alter the coupling circuit in a tuned amplifier such as to change the bandwidth of the amplifier.

System of Depth Measurement in the Acoustic Fathometer or the Like . . . Patent No. 2,736,000. Shinpei Nakano and Iku Yosano, Minato-ku. (Assigned to International Standard Electric Corp., New York, N. Y.)

A method of measuring the depth of a body of fluid. The system operates like an ordinary fathometer except that a double reflection is used. The transmitted signal is reflected first off the bottom and again at the surface so that the elapsed time measures twice the depth of the fluid. It is possible to measure the depth without knowing the distance between the transducer and the surface of the fluid.

Coarse and Fine Measuring System . . . Patent No. 2,736,008. John H. Miller. (Assigned to Weston Electrical Instrument Corp., Newark, N. J.)

An electrical system for measuring distance on both a fine and coarse scale. The current through a coarse control potentiometer is read on one meter which is calibrated in a coarse scale, for example, feet. A fine adjustment potentiometer supplies a current to a second meter (which is calibrated in inches) as well as to a second coil on the first meter. Thus, the first meter reads total distance while the second meter can be used to measure small changes in distance.

Process of Electrostatic Printing . . . Patent No. 2,735,784. Harold G. Grieg and Charles J. Young. (Assigned to Radio Corp. of America) **Process of Electrostatic Printing** . . . Patent No. 2,735,785. Harold G. Grieg. (Assigned to Radio Corp. of America)

A printing process in which an electrostatic field forms a dry powder image. This image is then converted into a black color on heating.

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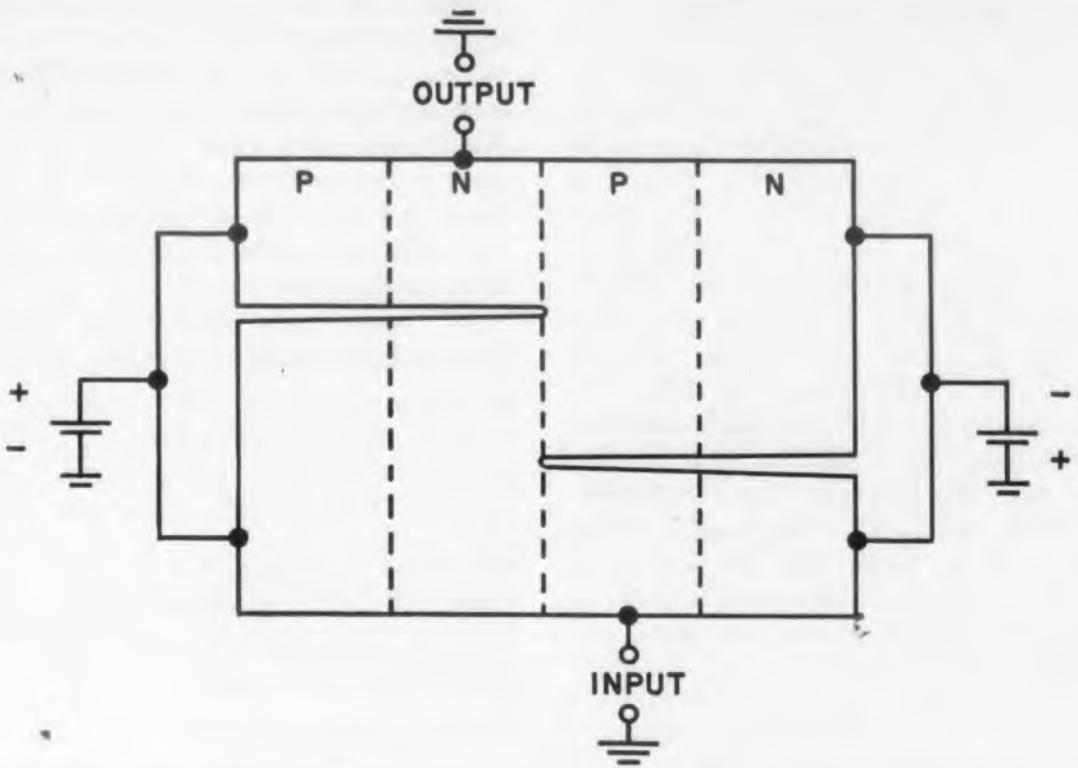
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Multielement Semiconductor Devices . . .
Patent No. 2,735,948, George C. Sziklai.
(Assigned to Radio Corp. of America.)

An electrical device comprising a semiconductor body having four alternating regions of P-type and N-type material. A

simplified diagram is shown below. The biases are so arranged that in operation the device is effectively a three stage grounded emitter amplifier. The first and third stages utilize a n-p-n type structure while the second stage uses a p-n-p type.



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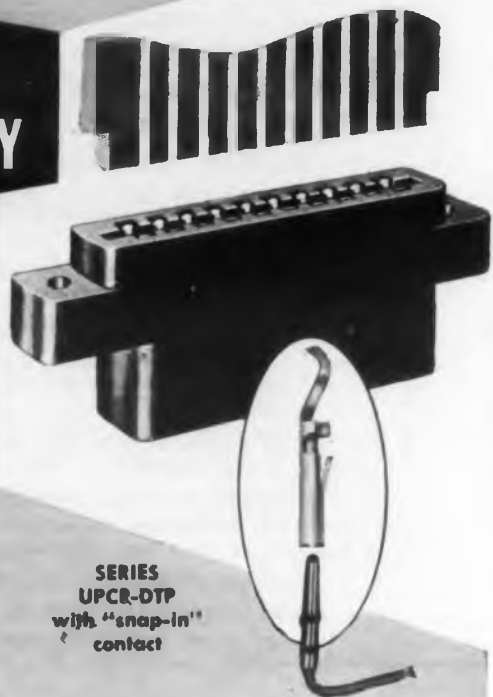
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Books

Reactor Shielding Design Manual . . .
Theodore Rockwell, III. D. Van Nostrand Co., Inc., Princeton, N. J. 467 pages.

Based on work of the Naval Reactors Branch of the Atomic Energy Commission in the design, construction and testing of shielding for reactor plants, this volume has wide application to many other projects. The design methods described include detailed illustrations of the use of general formulas in actual shield design, as well as brief derivations of many of them.

The section on materials deals with the basic components of shields, such as concrete, iron, stainless steel, lead, polyethylene, and various borated compounds. These are treated in detail and the economic comparison of various concretes should be of particular interest and value to the shield designer.

There are also useful tabulations and figures on flux to dose conversion, build-up factors, gamma rays resulting from neutron capture, and various formulas for different shield geometrics. Additional features include a discussion based on actual experience of placement of coolant machinery and structure inside the secondary shield. Hints and graphs for determining source points in a numerical procedure for finding attenuation through shields are helpfully given.

Electronics In Industry . . . *George M. Chute. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. 431 pages, price \$7.50.*



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This book presents the basic fundamentals of electronic devices as needed by men in industry, and explains how these devices are used in practical circuits. The author stresses the use of vapor or gas tubes. Several laboratory electronic instruments are discussed, as well as the many non-electronic devices often used in electronic equipment.

In this second edition, recent designs of industrial controls have been substituted. Those for resistance welding are covered more completely. A chapter has been added on simple closed-loop systems, giving a basic introduction to servos and the new field that includes automation.

The material is arranged and supplemented so that it may be used for a general or survey course by university students of mechanical, chemical, civil or aeronautical engineering; it can also be used as a supplementary text in electrical engineering.

The book supplements the material found in more specialized texts; its objective is to awaken interest in various phases of industrial electronics so that the reader is encouraged to use other texts for a complete coverage of the desired subjects.

R-F Transmission Lines . . . Alexander Schure. John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y. 63 pages, price \$1.25.

This book has been organized to help the reader to understand the important ideas pertaining to the basic types of r-f transmission lines. A minimum of mathematical treatment has been employed, but the analyses are sufficiently extensive to permit the practicing engineer to develop these fundamental concepts and basic applications to best advantage.

Specific attention has been given to the various types of line in common use; the problem of lumped and distributed constants; variations of constants; characteristic impedance; line termination; standing waves; standing wave ratio; input impedance; line losses; the half and quarter-wavelength line; resonant lines; the Lecher wire line; supporting stubs; delay lines; and artificial transmission lines.

A number of sample problems are given in sufficient detail, wherever applicable and pertinent, to permit the reader to apply the demonstrated procedures to situations that may confront them.

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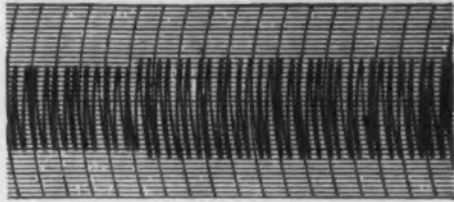
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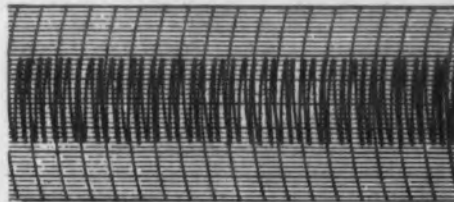
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Reliability Factors For Ground Equipment . . . Keith Henney. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. 12 chapters, price \$7.50.

This book discusses the numerous reasons why military electronic equipment does not have the necessary reliability. Statistics pinpoint the most likely and most prevalent malfunctions and finally, ways by which greater reliability in future equipment can be accomplished are pointed out.

Although primarily aimed at the designers of ground equipment, the problems and most of their solutions are general and the techniques are applicable to industrial as well as military equipment designers.

The book covers useful fundamentals of statistical methods, electrical and mechanical engineering principles, the human engineering side of the problem, some broad principles governing the selection and use of component parts and tubes, and some comments and data on training and service manuals and maintenance. All are dealt with for their effect on reliability and interest to the equipment designer.

Manufacturers' Agents Guide . . . Manufacturers' Agent Publishing Co., 505 Fifth Ave., New York 17, N. Y. 126 pages, price \$10.00.

This directory contains approximately 9000 names of manufacturers who distribute their products through manufacturers' agents. The guide provides a comprehensive, alphabetical listing of the manufacturers and their addresses, and includes information on their principal products, estimated financial strength and the name and title of the sales executive.

The guide details the appropriate steps to follow in communicating with manufacturers, suggests commission scales for various products, and provides data on operations as an agent.

Legal Problems in Engineering . . . Melvin Nord. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 391 pages, price \$7.50.

This book covers almost every legal subject bearing on engineering, with a view to helping avoid legal action in the first place, and permitting effective collaboration with lawyers should difficulties eventually arise.

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The author first explains legal principles in text style and then presents actual cases to exemplify each topic covered. These examples conclude with a succinct summary of the court decision. Problems are also included for the purpose of putting the principles in factual context, but here, the author refers the reader to the specific case rather than providing its solution.

Specific points covered in the book are: contracts, sales, negotiable instruments, insurance, personal property, real property, torts, workmen's compensation, agency, business organizations, municipal corporations, labor law, ethical responsibilities of engineers, professional registration of engineers, construction contracts and specifications, governmental regulations of business, patents, copyrights, trademarks, and air and stream pollution.

Office Work and Automation . . . Howard S. Levin. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 203 pages, price \$4.50.

Information handling is the central theme of this book. The author views the

office as a kind of "information factory," turning raw information into processed information that serves a management objective. Integrated data processing facilitates the initial handling of information, electronic computers aid in the processing of information, and operations research contributes to the use of information.

The author primarily directs the book to the management profession, and he presupposes little direct association with office machines or office methods. Greater emphasis is given to specific techniques. It defines and explains basic concepts and provides a stimulating view of potentialities. Included are useful illustrations, charts, and tables.

The book provides a basic understanding that will be helpful to the manager in organizing programs to obtain more effective information. It will aid in setting goals for such programs and in directing the work of staff specialists.

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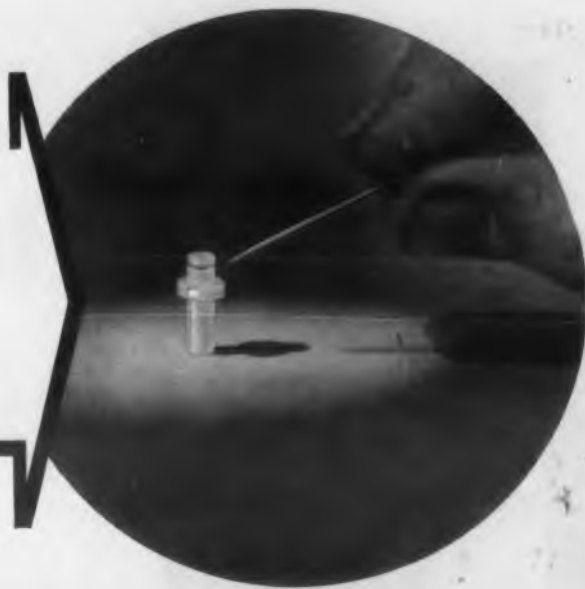
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Fig. 1

Soviet Analog Computer

THIS analog computer, called the EMU-5, was developed in 1954. The design objectives were small size and low current consumption. It consists essentially of a linear computer 1 intended for solution of linear differential equations up to the sixth order inclusive, a non-linear attachment 2 to solve non-linear differential equations, oscillograph 3, power supply 4, and auxiliary control unit 5, Fig. 1.

The non-linear portion comes also in a different variant using a multiplication-division block and a functional converter designed to reproduce prescribed fixed functions. The linear portion measures 690 x 600 x 500mm, the non-linear portion measures 690 x 500 x 350mm, the power supply measures 360 x 485 x 287mm. (One individual multiplier and one function

converter unit fits between the handles of the linear unit if this scheme is used.)

The power drain of the linear portion is approximately 254w, and that of the non-linear portion is approximately 500w.

Additional auxiliary equipment consists of a functional converter employing a delay circuit, an electrohydraulic converting device, and a coefficient-varying device for solving equations with time-variable coefficients.

The linear section of the equipment consists of 12 computing amplifiers with automatic zero-level stabilization, 30 resistance boxes permitting variation of a transfer coefficient over a range of 100 to 1 (for amplifiers) or 10 to 1 (for integrators), and bridge-type

voltage dividers which permit continuous adjustment of the transfer coefficient from 1 to 0.001, Fig. 2.

Fig. 4 shows the method of switching the input resistance, feedback resistance, and voltage dividers together with the computing amplifiers, to vary and establish the required transfer coefficient. Fig. 5 shows an alternate circuit for adjusting the transfer coefficient of the computing amplifier.

The non-linear section contains also 6 dual computing implifiers for sign reversal, Fig. 3, and 12 computing amplifiers with automatic zero-level stabilization. The non-linearities of elementary functions are reproduced with the aid of diode circuits, using the piecewise linear approximation. Different non-linear functions are obtained by various combinations of

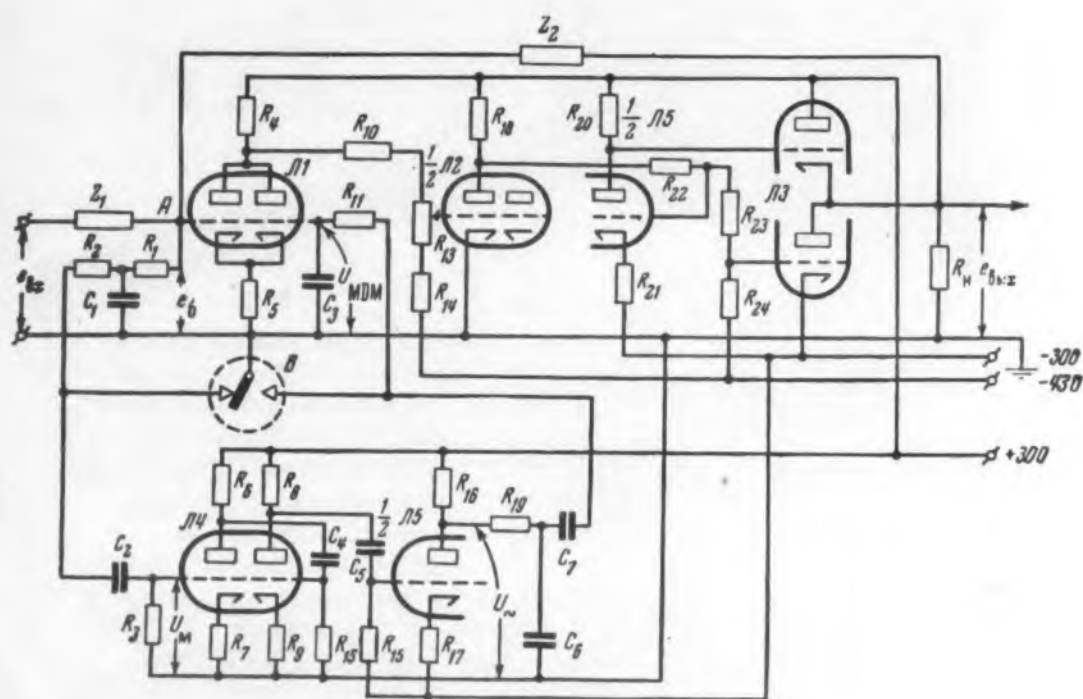
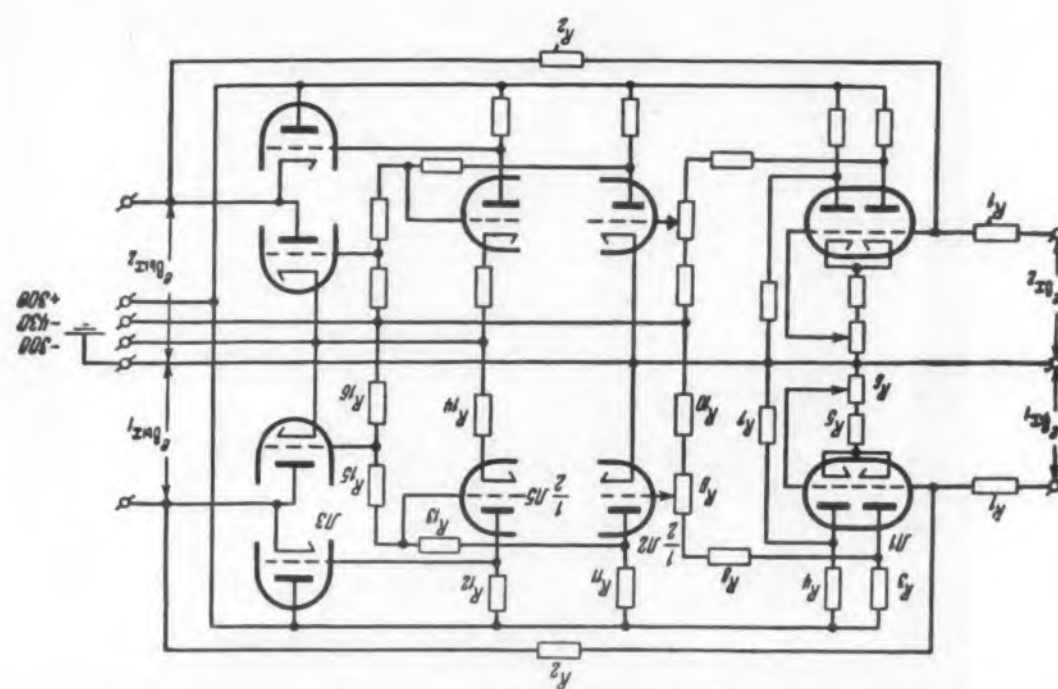


Fig. 2



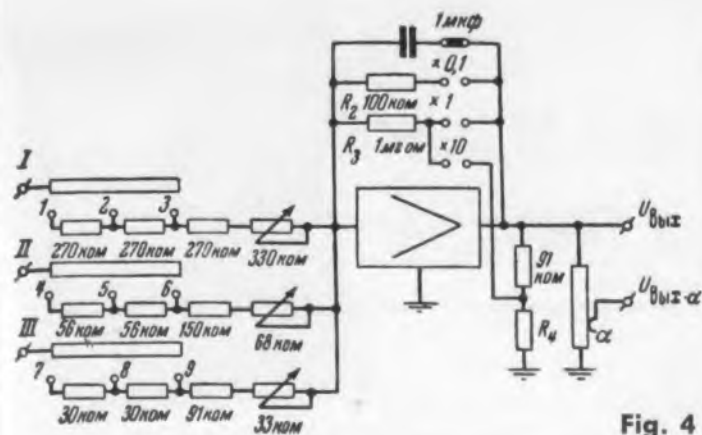


Fig. 4

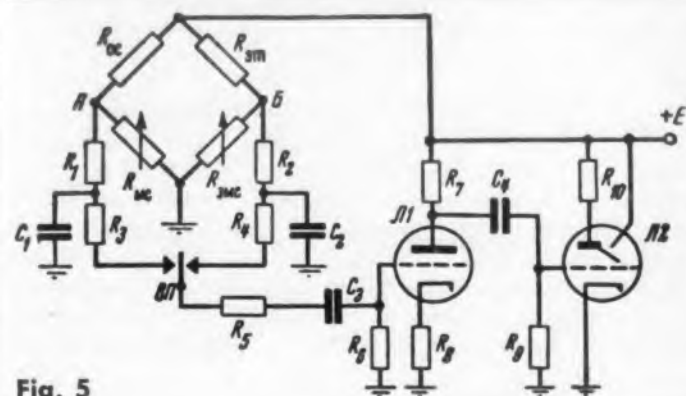


Fig. 5

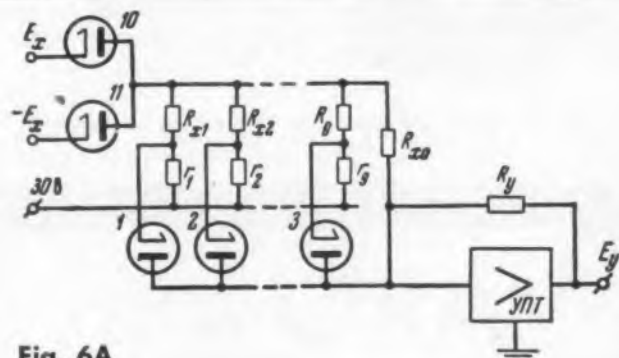


Fig. 6A

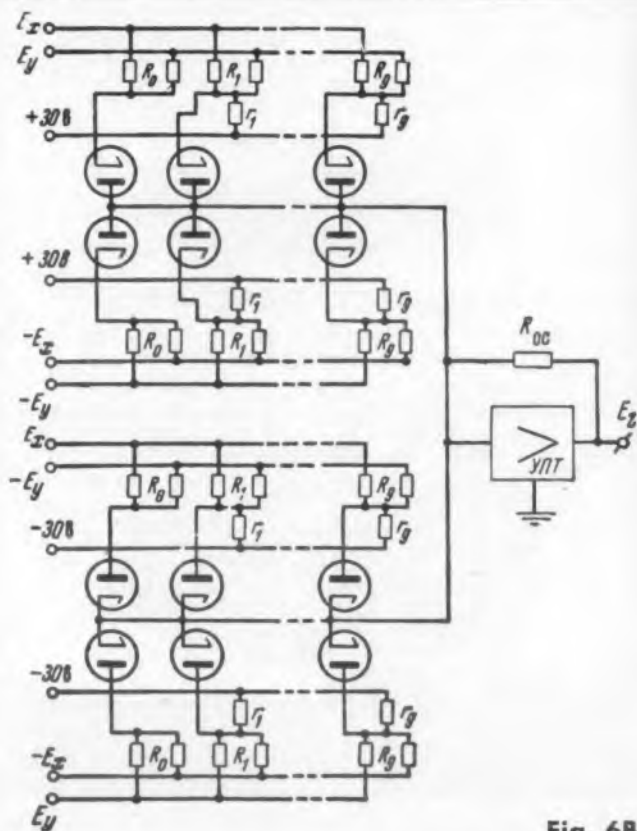
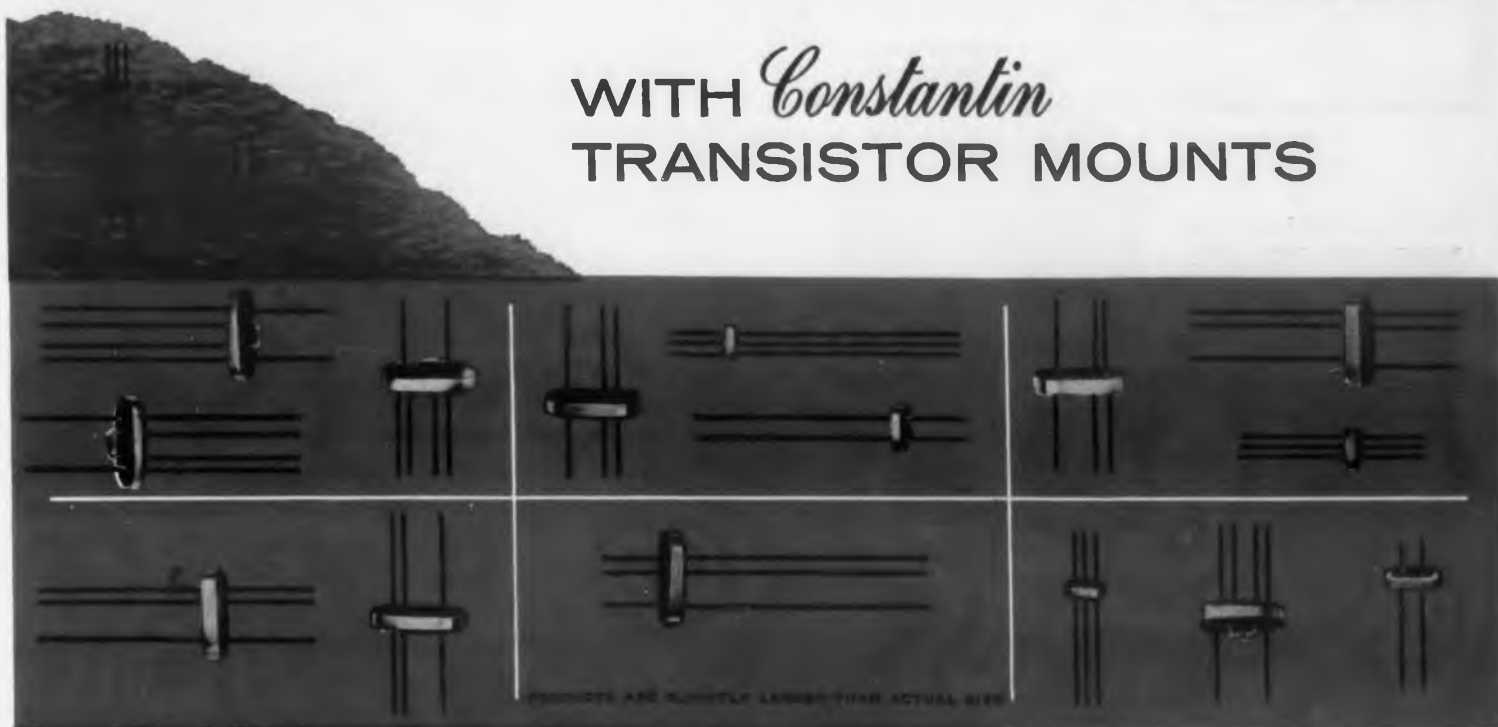


Fig. 6B

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diodes and resistors. Considerable economy in the number of resistances used is obtained by using diode elements in which one electrode of the diode, always connected to the summing point of the computing amplifier, is "virtually grounded," (Fig. 7) a single voltage divider, connected between the source e and the source E_x makes it possible to adjust the value of the transconductance of the diode and the value of the required bias voltage. This principle of virtual grounding of the diode permits also employing a diode element that has summing properties, in which several input voltages can be connected to equal resistances. Fig. 6a shows the use of the diode block to produce a quadratic function, while the Fig. 6b shows the circuit of a multiplying diode block.

The functional converter diagram is shown in Fig. 9, and the block diagram of the multiplication-division circuit is shown in Fig. 8.

The control circuit of such an installation consists of starting, and resetting devices, as well as devices for transfer switching, for setting the initial conditions, for adjusting the transfer coefficients of the individual blocks, and for inserting various perturbations to the systems. Control is effected by means of pushbuttons located on the front panel of the linear portion of the computer, but the non-linear section can be controlled either from the linear panel, or else directly at the non-linear portion itself. An additional control block marked DBU-5 performs the following func-

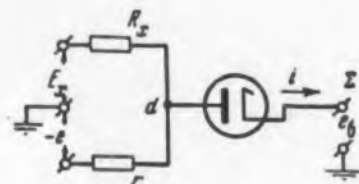


Fig. 7

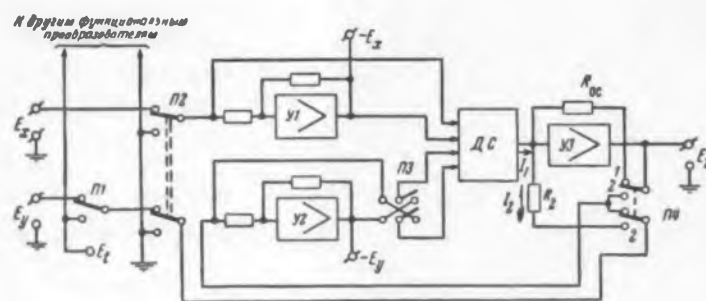


Fig. 8

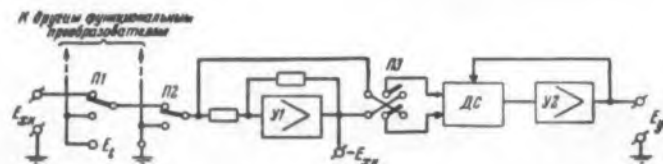


Fig. 9

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tions: *a* Varies the period of the process from 2 to 50 seconds and automatically stops the process at a definite instant; *b* Switches on or off the input signal at a definite prescribed instant of time; *c* Reconnects the circuit at a definite time; *d* Produces time markers for a cathode ray indicator tube with long-persistence screen; *e* Switches the vertical plates of the cathode ray tube of the oscillograph to permit simultaneous observation of two processes.

The Fig. 10 illustrates the principles of the control method employed, and Fig. 11 shows an overload indicator for the computing amplifiers. Condensed from an article "New Electronic Analogue Apparatus of the Institute of Automation and Remote Control of the USSR Academy of Science, V. V. Gurov, B. Ia. Kogan, A. D. Talantsev, and V. A. Trapeznikov. *Automatika I Telemekhanika*, No 1, Jan. 1956.

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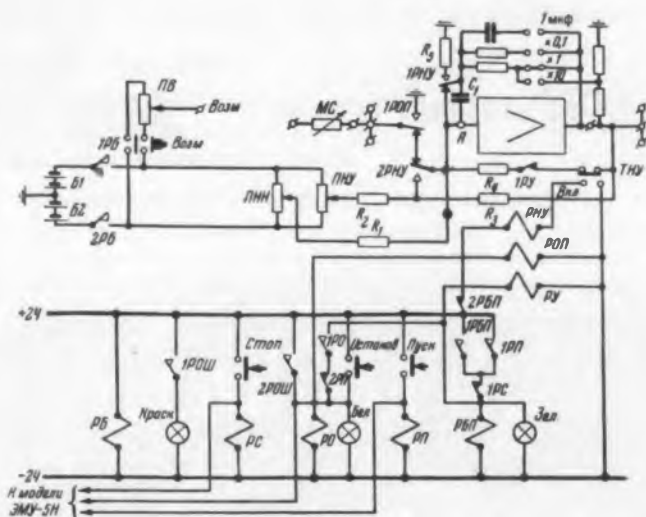


Fig. 10

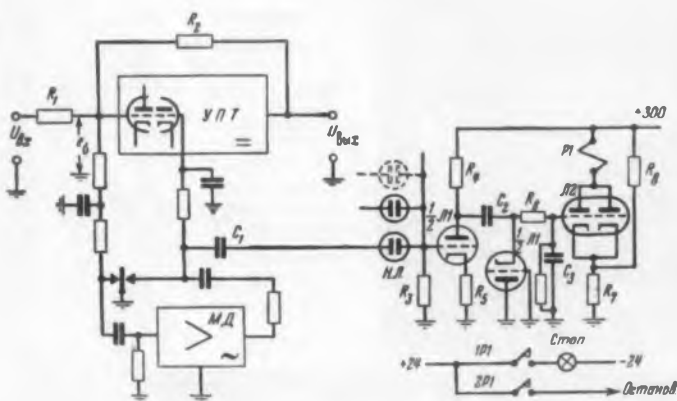


Fig. 11



Military Capacitors

MIL-C-25 Types
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Electronic

Monthly

WE just received the first issue of *Radiotekhnika i Elektronika* (Radio Engineering and Electronics), a new monthly published by USSR Academy of Sciences, devoted to original reports and survey articles on theoretical and experimental advances in electronics and electron physics. The editor-in-chief is V. A. Kotelnikov, and he is assisted by D. V. Zernov and Iu. B. Kobzarev. The editorial board numbers some of the most prominent Russian scientists in the field and consists of A. G. Arenberg, A. I. Berg, V. A. Vvedenskii, N. D. Deviatkov, L. I. Dobretsov, A. F. Ioffe, S. G. Kalashnikov, P. L. Kapitsa, M. S. Kozodoiev, A. L. Mints, A. A. Pistol'kors, A. M. Prokhorov, S. M. Rytov, S. E. Khaikin, and B. M. Tsarev. Many of these names are by now familiar to readers of "What the Russians are Writing," and the inclusion of Peter L. Kapitsa is an indication that electron physics will be prominently featured.

The last page of the magazine carries an announcement by the editorial board that the periodical will be devoted to the following topics:

U.H.F. electronics and instruments.

Electron emission.

Semiconductor electronics and instrumentation.

Discharges in gases and ionic instruments.

Electronic instruments (theory, design methods, new principles, and new types).

Electron optics and electron-optical instruments.

Vacuum techniques.

Antennas, feeders, waveguides, and cavity resonators.

Propagation of radio waves (in troposphere and ionosphere).

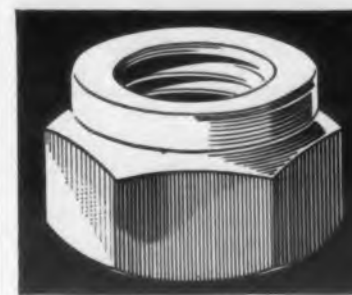
Communication theory.

Statistical radio-physics—(noise, thermal radiation, propagation of radio waves in statistically inhomogeneous media).

Frequency stabilization (parameteric, piezoelectric, molecular).

Theory or radio circuits.

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Radio-circuitry elements.
Radio astronomy.
Radio spectroscopy.
Radio-engineering and electronic applications
in science and industry.
Radio-engineering and electro-vacuum materials.

The magazine will also publish proceedings of conferences and conventions held by the USSR Academy of Sciences organizations, and will report on foreign conferences in which its members participate.

Like all other Russian publications of interest to its readers, ELECTRONIC DESIGN will abstract this magazine regularly. The contents of the first issue is given below, and a summary will be published as soon as possible.

Radio tekhnika i Elektronika, Vol 1 No 1, January 1956.

Cold Cathode Emission and Emitters, D. V. Zernov, M. I. Elinson.

Time-Duration Distribution of Normal-Fluctuation Deviations, V. I. Tikhonov.

Effect of Semi-conducting Film on Attenuation of Electromagnetic Waves in Waveguides of Circular Cross Section, V. V. Malin.

Effect of Insulator Secondary Emission on the Stability of Vacuum Tube Characteristics, N. V. Cherepnin.
Possibility of Extending the Similarity Concept to Multiple-Cavity Magnetrons with Different Numbers of Cavities, I. E. Rogovin.

Coherent Electron Beams in Synchrotrons at Centimeter Frequencies, E. S. Voronin, R. V. Khokhlov.

Mutual Synchronization of Reflex Klystrons, R. V. Khokhlov.

Shot Effect in Semiconductors, L. Ia. Pervova.
Photocells and Photo Multipliers with Magnesium Cathodes for Recording Ultraviolet Rays, O. P. Dorf, N. G. Kokina, T. M. Lifshits, D. A. Shklover.

Discussions and brief notices.

Russian Atomic Energy Publications

The 87 scientific and technical papers on atomic energy presented at a conference sponsored by the USSR Academy of Sciences in Moscow, July 1955, have been translated into English and are being published in four volumes.

Volume 1, physico-mathematical sciences covers properties of heavy elements, work on uranium-graphite reactors, and lattices, radiation effects etc., 23 papers, \$1.25. Volume 3, treats application of nuclear technology to industrial processes and prospecting. 18 papers, \$1.00. Volumes 2 & 4 cover chemical and biological sciences, respectively.

These volumes will be available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C.

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Abstracts

Naval Research Laboratory Reports

The Office of Technical Service, U. S. Department of Commerce recently undertook to distribute the monthly "Report of NRL Progress." This is another endeavor on the part of OTS to bring to the attention of industry engineers results of work either being done by the government or under government sponsorship. The Editors of *ELECTRONIC DESIGN* are very happy to help OTS "pass the word." We are particularly impressed with the style of the report of the NRL Progress. It gives the reader understandable information efficiently. We are reproducing excerpts of interest to electronic designers here to give you an idea of the report's organization.

You can subscribe to this monthly by applying to OTS, Washington 25, D.C., price \$1.50 per year. (Each issue contains reports on the following subjects: astronomy and astrophysics; chemistry; electricity; mathematics; mechanics; metallurgy and ceramics; nuclear and atomic physics; optics; radio; solid-state physics. Each issue also contains several feature articles on some of these subjects. A typical issue is about 60 pages in length.)

January 1956

L-Band Amplifier

Background: The characteristic most generally sought in the design of receivers for radar systems is a low noise figure. In the present state of the art the lowest noise figures for conventional receivers are obtained with crystal mixer front ends above 2000Mc and with r-f amplifiers using coplanar triodes below 1000Mc. This is due to the fact that the internal noise of triodes increases with the radio frequency while that of crystals remains essentially constant. Between 1000Mc and 2000Mc, and particularly in the 1250-1350Mc band used for many search radar systems, the two types of front end are competitive. Although crystal mixers under optimum conditions have a slight edge of about 1db in noise figure, and are, in general, simpler and less expensive, they are much more subject to burnout and hence require greater protection from the duplexer. It may be advantageous, therefore, to use an r-f amplifier front end in some cases, particularly in modifying existing radars where crystal burnout is known to be severe.

Progress: Radio-frequency amplifiers for L-band radar receivers afford considerably greater reliability than do crystal mixers, which are subject to burnout. Thus, they may prove desirable for many radar systems in spite of the fact that crystals provide slightly better noise figures under optimum conditions.

A simple and compact coaxial cavity amplifier for the 1250-1350Mc range has been designed using a GL-6299 (Z-3011) triode. The input is taken from a tunable TR cavity by means of an adjustable loop, and the output is fed to a Point-type mixer. Tuning is accomplished by a simple susceptance screw parallel to the cavity axis.

Noise figures ranging from 8.0db to 8.5db were measured. Available as a separate report *PB111907*, "A Low-Noise L-Band Amplifier" by L. Hoffman and H. Montague, III, Feb. 1956, 8 pages, \$0.50. Order from OTS.

Circularly Polarized Antenna

Background: A type of antenna which has been under study consists of crossed slots cut in the wall of a rectangular waveguide in such a way as to radiate circular polarization.

Progress: A pair of narrow slots crossed at right angles and located at the proper point in the broad wall of a rectangular waveguide will radiate a circularly polarized wave. Some of the results of a study of the properties of such slots is presented. The study was undertaken with the aim of obtaining information useful in design of a circularly-polarized linear array.

Some of the properties of the slot pairs are as follows: 1. They are inherently matched, independent of the slot length. 2. When the slot arms are made resonant, approximately 75% of the incident power is radiated, with a VSWR of 1.12. 3. When fed from one end of the waveguide, the slots radiate right hand circular polarization; from the other end, left hand.

In using these slots in linear arrays the power radiated is varied by changing slot length since position and orientation are fixed by the requirements of circular polarization. The slots must be separated by a guide wavelength, so waveguide loading or other complicated schemes must be used to reduce the slot spacing. Available as a separate report *PB111904*, 14 pages, \$0.50. Order from OTS.

The January issue also included a brief feature article, describing "Chopper for 8.7-Millimeter Wavelength." The unit is lighter in weight and more com-

fact that conventional choppers, it has an attenuation in excess of 52db at an average VSWR of 1.02, and it produces a sine-wave modulation. It is based on a rotary vane attenuator principle. A. I. Reynard, Radio Astronomy Branch, Atmosphere and Astrophysics.

February 1956

Receiver Antenna Filters

Background: A general problem associated with the use of receiving equipments in an area of strong transmitted signals is that of reducing the strength of undesired signals to a level which can be accepted by the receivers, or, where used, by the receiver multi-couplers. The use of trap filters inserted in the antenna system transmission line offers an obvious solution. The filters must exhibit a high attenuation at the frequency of the unwanted signal, and low insertion loss at all other frequencies.

Progress: Measurements performed on commercially developed filters (70-ohm impedance and for use from 2Mc to 32Mc) and a subsequent analysis to determine what maximum performance might be achieved, led to a design goal of a minimum attenuation of 40db at a skirt width of ± 10 kc relative to the rejected frequency, and a maximum insertion loss of 3db at a skirt width of $\pm 5\%$ of the rejected frequency. In addition, the loss should drop gradually to 1db or less over the remainder of the band.

A series of five filters covering the band from 2Mc to 30Mc has been designed and constructed. The attenuation at the ± 10 kc points rises from a value of 48db at 2Mc to 70db at 30Mc. Attenuation values at $\pm 5\%$ of the unwanted frequency are all less than 2db. With all five filters in the circuit, which would be the case for rejection of five strong signals from an antenna circuit, the maximum attenuation for areas of desired signal frequencies is 1db. D. B. Keever and M. L. Leppert, Radio Division, Communications Branch.

Research on Millimeter-Wave Components

Background: The millimeter-wave research program was initiated at NRL to investigate the properties and possible military applications of the frequency range above 26,000Mc. Since there were no components or test equipment for the millimeter-wavelength region available at the time, a development and evaluation program was undertaken which covers the millimeter-wavelength range from 4mm to about 1cm.

Progress: The development and characteristics of a series of waveguide components and test equipment, covering the portion of the millimeter-wavelength range 4mm to about 1cm, have been investigated. Included are connectors, standing-wave indicators, wave-meters, attenuators, directional couplers, switches, hybrid junctions, adjustable shorts, crystal mounts, power meters, power supplies, terminations, bends, horns, tees, and tapers.

A final report on the problem will be published in the near future as NRL Report 4704, "Millimeter-Wavelength Components" by R. G. Fellers and J. A. Kaiser, Electronics Division, Microwave Antennas and Components Branch.

Rapid Scan Microwave Antenna

Background: Required is the development of rapid scanning antenna designs not unreasonably difficult to build or too heavy to install. A solution depends on designing a focussing objective with good off-axis performance, and on finding a means of obtaining a specified feed motion.

Progress: In the parabolic torus (see NRL Report 4141), rapid scanning of the beam is obtained with an organ-pipe feed system. This antenna has good radiation patterns in the two principal planes but has an objectionably high sidelobe in an intermediate plane owing to inherent phase errors in the parabolic torus. Therefore, attention has been directed toward improving the reflector surface to accomplish a reduction in phase errors.

A new reflector was derived by assuming a toroidal surface, thus utilizing the rotational symmetry of the parabolic torus as before, but determining the generating curve to provide a more optimum balance of phase errors over the illuminated area. The generator curve thus derived was a portion of an ellipse. Phase errors from this new reflector, an elliptical torus, are approximately one-half the magnitude of those from the parabolic torus. Therefore, this elliptical torus can produce better beam characteristics than the parabolic torus. This has been verified by measurements on experimental models of the elliptical torus. For the same f/D (ratio of focal length to diameter) the elliptical torus shows sidelobes down about 4db from those of the parabolic torus. Also beamwidths are smaller indicating increased aperture efficiency. D. H. Archer, Electronics Division, Microwave Antennas and Components Branch.

Klystron Power Supply

Background: In klystron power supplies a need has been felt for a relatively simple d-c voltage regulator which would operate over a wide range of d-c output voltages and currents with a minimum of switching.

Although there are commercial voltage regulators available that will provide low ripple and stable d-c output voltages, these are expensive, complicated, bulky, and hard to incorporate into existing equipment.

Progress: A circuit, which compared to conventional power supplies is simple to construct and has relatively few parts, has been built to give low ripple over a wide range output of voltages and currents (schematic given in Report). The following results were obtained: 1. Regulated d-c from $-400v$ to $-1000v$ with no switching. (A $400v$ $4000v$ range is possible by switching two resistors.) 2. Low ripple voltage of



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under 10mv was easily obtained over the above voltage range. Under optimum conditions the ripple was as low as 1.5mv at -4000v. 3. A wide range of output currents, depending on the series tube chosen. With an 810 series tube, load currents from 0ma to 100ma were obtained. 4. All tube sockets, filament supplies, and VR tubes are at small potentials with respect to ground. This reduces the hazard to personnel as well as the possibility of failure due to voltage breakdown.

The reduction of hum is good enough to permit the use of the regulator with a supply of poor ripple factor. The regulator was used with a supply where the only filtering was provided by a 2μfd condenser. With 3500v out and series tube current 30ma, the ripple was 0.009v. With 2500v and 100ma, the ripple was 0.02v. D. H. Phillips, Electronics Division, Microwave Antennas and Components Branch.

March 1956

Magnetic Amplifiers

Background: In control applications an analog dividing circuit containing no moving parts has been needed. Magnetic cores offer possibilities.

Progress: The fact that a magnetic core requires a given number of volt-seconds to be driven from saturation in one direction to saturation in the other direction has been utilized to build a dividing circuit. This circuit, employing switching transistors and a single high-remanance magnetic core, provides an output voltage whose average value is the quotient, with the correct sign, of two input voltages. A preliminary model of the divider gives accuracies of ±2.5% of full-scale readings for a quotient range of one hundred to one and input variation of both numerator and denominator of better than ten to one. By varying the waveforms of the inputs, a much more general computing element whose output is proportional to various functions containing quotients can be obtained. An interim report on this problem will be published in the near future as NRL Report 4702, "Analog Computation of Quotients and Functions Containing Quotients Using Magnetic Cores" by D. H. Schaefer, Solid State Division, Applications Branch.

April 1956

The Microwave Turnstile Circulator

Magnetically biased ferrites are being used to impart nonreciprocal properties to new types of microwave components. One of the most important of these new components is the microwave circulator. The turnstile circulator, a simple nonreciprocal four-part network, is perhaps the simplest form of circulator yet described since it requires but a single junction and a 45 Faraday rotator. Although a "narrow band" device, the turnstile circulator can provide high isolations over usable bandwidths, with very low insertion loss. Theoretical curves permit prediction of isolation bandwidths. Applications include electronic lobe switch-

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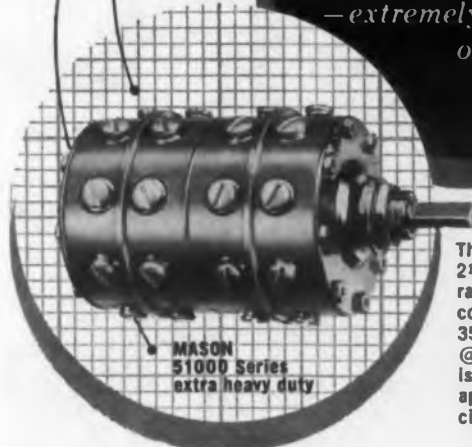
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ing, load isolating, and duplexing. 8 pages; P. J. Allen, Tracking Branch, Radar Division.

Propagation in Ferrites

Background: A basic study of the propagation characteristics of ferrite materials at microwave frequencies is being pursued. The phase-shifting, attenuating, and non-reciprocal properties of various materials in waveguides and coaxial lines as functions of an applied dc magnetizing field are of particular interest. Information derived from this study is applied to the design of new type microwave components and antennas.

Progress: The power absorbed by a ferrite-loaded rectangular waveguide increases with power level. As an example, differential phase shift sections having less than 0.25db loss at klystron power levels were found to have from 5db to 10db of loss at peak powers of 100kw. Two methods of obtaining good ratios of differential phase shift to power loss have been found:

1. The first method involves the use of ferrite slabs of small height and large width (40% of the guide). With such a design it is possible to build a 90° differential phase shift section with less than 1db of loss at 100kw.

2. It was felt that some of the increase in loss was due to the incidence of high-order modes which depend on the height of the ferrite slab and of the waveguide. Therefore, a septum was placed perpendicular to the narrow walls of the guide, in the thought that this system would suppress those modes which have an E-component parallel to the broad face of the waveguide. While hardly affecting the phase shift, the high power loss was reduced in db to about 40% of its previous value. Further work will be carried out to determine if one or more septa can be used to reduce the high power losses of other geometrical configurations. (See also earlier mention in January 1956 issue above.) H. N. Chait, Electronics Division, Microwave Antennas and Components Branch.

The April issue contained a feature article, Some Recent Advances in Radio Astronomy at NRL. The abstract of the article is as follows: The first decade of radio astronomical research at NRL has been unusually active and fruitful. Some of the more recent results include the discovery, development, and application of spectral absorption-line techniques for studying interstellar hydrogen gas. The development of the theory for the hydrogen case suggests that absorption methods enhance the possibility of detecting microwave spectral radiations from other interstellar atoms, molecules, and radicals. There has also resulted from these studies the first radio measurement of a cosmic red shift, using the radio source Cygnus A. The recently obtained radio data provide strong new support for the Doppler interpretation of the cosmic red shifts, upon which is based the concept of the expanding universe. 7 pages; A. E. Lilley, Radio Astronomy Branch, Atmosphere and Astrophysics Division

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Abstracts



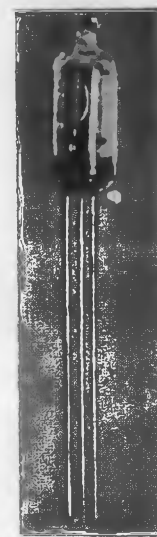
Soldering

Miniature Connectors

MINIATURIZATION of electronic equipment has required the use of special soldering irons or other soldering equipment to successfully solder the small components into the circuit. Standard soldering iron tips are sometimes larger than the entire component. Small-size soldering irons usually do not provide sufficient heat to prevent cold joints. The use of a large iron with the tip cut down is discouraging as the large voltage heating element overheats the small tip and it soon oxidizes and burns up.

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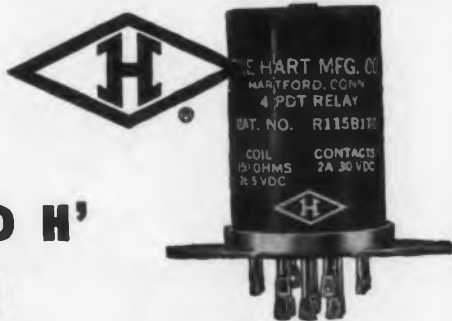
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Excessive current flow through the miniature contact must be avoided if the contact is to remain undamaged. If this current is permitted to flow for a long period of time, the heat generated within the contact will be sufficient to anneal this contact. This annealing will remove the spring qualities from the metal and a "dead" contact results. Also, the contacts may weld together which will damage the connector when an attempt is made to disconnect one from the other.

One method of soldering to the miniature connector is to use a two-prong electric soldering device. This outfit consists of a two-prong soldering gun and a transformer with timer. The two-prong gun is applied to the contact only where the heat is needed—on the solder pocket of the contact. Then the amount of heat is carefully controlled by the timer built into the transformer unit. The length of time is adjusted so that current flows through the connector solder pocket and wire just a sufficient time to permit an adequate solder joint. Proper adjustment of the time permits just the right amount of heat to be applied to the miniature contact. Even the most inexperienced operator can be expected to get a good clean solder joint.

A second soldering method may be used in soldering leads to the miniature types of ribbon connectors. One lead of the soldering unit is connected to a block which is laid under and touches all contact tails on one side of the connector. The wire is laid into the contact solder pocket and the solder and the other contact of the solder unit applied to the contact. Thus, current flows through the wire and the contact tail only and a good solder joint will result.

The two methods described apply the heat to solder only where it is needed—on the solder pocket of the contact and the wire. The heat time can be controlled, and just the right amount of heat applied to assure a good solder joint. No heat is applied to the contacting surfaces or the spring portions of the contact, therefore there is no chance of damaging the miniature contact.

The use of a small-size two-prong soldering tip makes it easy to remove wires or add wires to the miniature connector even when the wire is in the center of the connector. The timer unit prevents overheating of the contact and is an aid in preventing excessive solder from flowing over the contact. *Abstracted from "Soldering Miniature Connectors," Harry M. Neben, Amphol Engineering News, March 1956, p. 344.*

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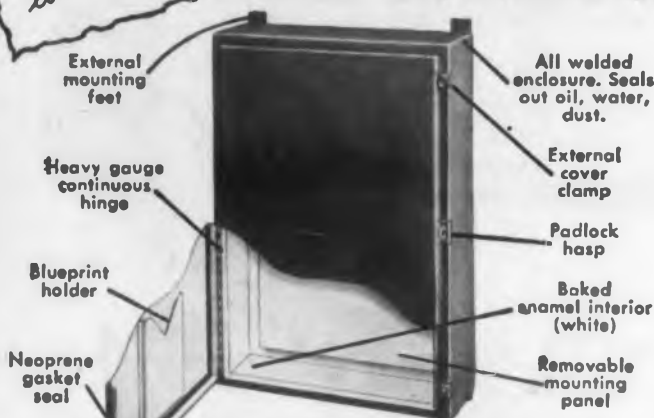
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Standards and Specs

Sherman H. Hubelbank

This department surveys new issues, revisions, and amendments, covering military and industry standards and specifications. Our sources of information include the Armed Services Electro-Standards Agency (ASESA), the cumulative indexes to Military Specifications, Vols. II, IV, American Standards Association (ASA) and other standards societies.

Mica

NEMA ME1-1956, MANUFACTURED ELECTRICAL MICA . . . Information concerning tolerances, bond content, nominal thickness and dielectric strength is given for mica splitting plates, sheets, and tapes; mica paper plates, sheets, and tapes; and round tubes. Muscovite and phlogopite (amber) mica splittings are classified, and the methods of measuring thickness, dimensions of tubes, dielectric strength, binder content, and moldability are described. Copies of this standard are available from NEMA for \$1.75 per copy.

Investment Castings

Designed to aid design engineers and other persons specifying investment cast parts, seven new material specs have been released by the Investment Casting Institute. These specs cover general iron-base carbon steels, low alloy steels, cobalt and nickel base super alloys, magnesium base, aluminum-zinc alloy, silicon-magnesium and silicon-copper, and silicon-brass. These new specs are identified by a code number in line with the new code number system developed under the Standardization Plan of the Secretary of Defense, as described in the publication entitled "Cross-Index of Chemically Equivalent Specifications and Identification Code", available from the Government Printing Office. Copies of the seven specs may be obtained for 70 cents from the Investment Casting Institute, 27 Monroe St., Chicago 3, Ill.

AIEE Standards

AIEE has announced the release of the following newly issued standards:

- 59, Proposed Test Code for Metallic Rectifiers
- C39.1, Electric Indicating Instruments (Panel, Switchboard and Portable Instruments)
- C50.1, Synchronous Generators, Motors, and Machines in General
- C50.2, A-C Induction Motors, Machines in General, and Universal Motors
- C50.4, D-C Generators, Motors, and Commutating Machines in General
- C50.5, Rotating Exciters for Synchronous Machines
- C50.6, Motor-Generator Sets

Copies of these standards are available from the American Institute of Electrical Engineers, 33 West Thirty-Ninth St., New York 18, N.Y. for a nominal cost.

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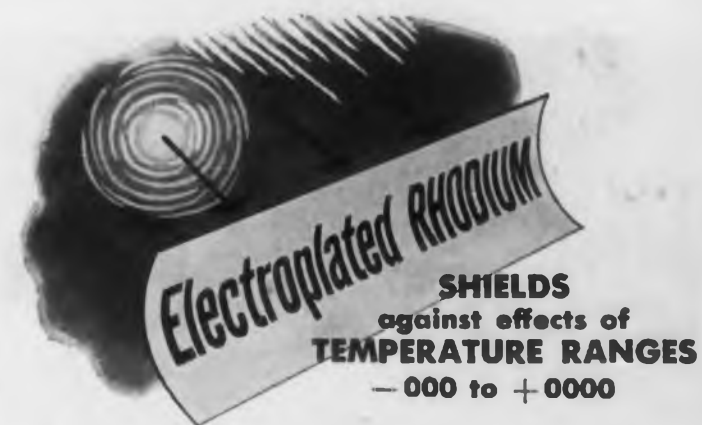
MIL-STD-208A, PART NUMBERING FOR MILITARY STANDARDS, 9 DECEMBER 1955 . . . Effective June 1, 1956, this standard is mandatory for use by the Departments of the Army, the Navy, and the Air Force. This standard provides a part numbering system for use in the preparation of Military MS (sheet form) standards. It defines an MS Part Number as a designation used to identify a standard part or item. It is composed of the number of the Military (MS) Standard Sheet on which the item is described and a serial (or dash) number assigned to each separate physical item listed on the sheet. It also defines a Military (MS) Standard. This standard is of a graphical form combined with tabular presentation if necessary. These MS Standards are limited to those dimensional and functional details necessary to insure interchangeability of the item.

Application Design Notes

The following Application Design Notes have been either revised or newly issued by ASEA:

Part Name	ADN Number	Date
Resistors, Fixed Film (Power Type)	11804	10 Feb 56
Connectors, Electrical, Power Bladed Type	3767	10 Feb 56
Filters, Radio Interference	15733	15 Feb 56
Switches, Rotary, (Circuit Selector, Low Current Capacity)	3786	20 Feb 56
Shunts, Instrument, External 50 Millivolt, Lightweight	61	15 Mar 56
Resistors, External Meter, High Voltage, Ferrule Terminal Type	29	20 Mar 56
Lampholders and Lights, Indicator	3661	30 Mar 56

Specifications listed on these pages are for information only and government contractors should be guided by their contracts. Copies of military specs should be obtained from sources recommended by procuring officers. ASEA bulletins may be obtained from Fort Monmouth, N. J. ASA standards may be obtained from American Standards Agency, 70 E. 45th St., New York 17, N. Y., unless otherwise noted.



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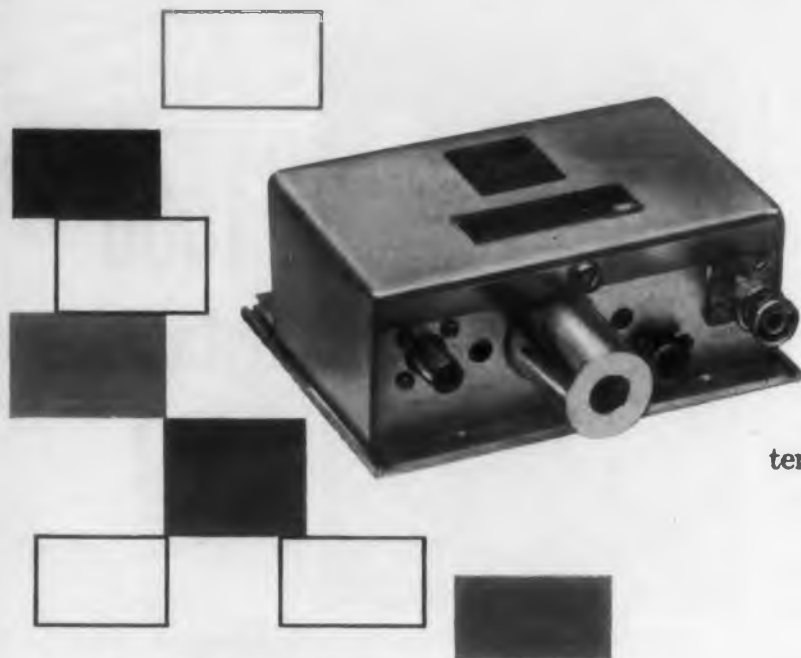
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January 1

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Plug-In Electronic Relay (p 38) Ultra-sensitive relay circuit such that an input power less than 0.1mw will control an output up to 115w. (Industrial Electronics Co. Inc.)

High Compliance Transducer (p 40) Describing a variable reluctance moving-iron transducer (Present models are phono pick-ups). Its differing characteristic is its extremely small and uniform loading of an input for wide range of frequencies. (Pickering and Co. Inc.)

Gas-Filled Cavity Wavemeter (p 42) A highly accurate temperature-compensated wavemeter such that it can be used as a secondary standard to calibrate other laboratory wavemeters. (De Morney-Bornardi)

Visual Frequency Response Indicator (p 44) A visual frequency response indicator mechanically operated by bass and treble control knobs of a hi-fi audio amplifier. It provides a visual frequency response over the audio range of the amplifier. (Bell and Howell Co.)

Fast Magnetic Amplifier (p 46) Small low-power, light weight magnetic amplifier that can operate up to frequencies of 10Mc. (Beckman Instruments Inc.)

Electro Static Loud-Speakers (p 88) A discussion of design considerations, acoustical factors and power output. (Abstract)

Low Frequency Tape Recording (p 90) Problems in recording low frequencies on magnetic tape. (Abstract)

Pulse Amplifier With Two Feed Back Loops (p 92) A d-c amplifier employing a second positive feedback loop to obtain sufficient gain with low response time and low overshoot. (Russian Translation)

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February 1

January 15

Evaluation of Electronic Test Equipment, by B. S. Browning (p 20) Discussing the advantages of evaluating test equipment to eliminate duplication of overlap in available equipment and avoid duplications in developing new equipment.

Loaded-Core Sandwich for Radomes (p 22) Metal loaded to substantially the same dielectric constant of its skin, this core behaves as much heavier solid half-wave radome materials. (Mc-Millan Industrial Corp.)

Designing Cathode Coupled Amplifiers with Conductive Curves by K. A. Pullen, Jr. (p 24) Design of highly non-linear amplifier stages, as well as the design of linear stages is simplified in many ways by the use of conductance curve techniques described herein.

Cored Forging Parts for Electronic Devices (p 28) How cored forging enables high-strength parts to be forged closer to their finished form than is possible in any other forging method. (National Cored Forging Co.)

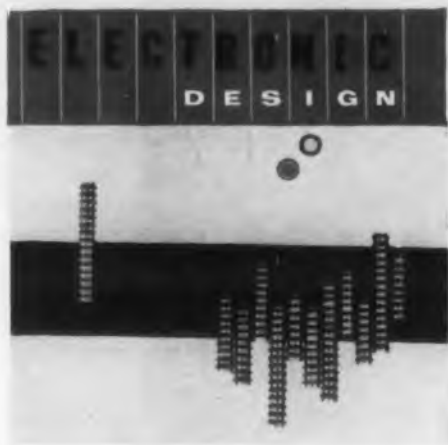
Thumb-Tuned Grid Dip Oscillator (p 30) Wire is paid off the tuner coil onto a storage drum to change the inductance in this unique grid dip meter. (Alto Scientific Corp.)

Multi-Trace Oscilloscope (p 32) Twenty-four inputs are displayed simultaneously on this oscilloscope which uses a television-type raster. (Southwestern Industrial Electronics Co.)

Accurate Oscilloscope Phase Shift Measurements, by H. D. Webb (p 34) More accurate determination of phase shift with a cathode-ray tube made by measuring the axes of the ellipse rather than a and b intercepts.

How to Evaluate Shielded Rooms, by E. A. Lindgren (p 36) A discussion of the evaluation of attenuation rating, mechanical construction, cost, and the environmental conditions under which a shielded room will be used.

Desk Size Digital Computer (p 38) A digital differential analyzer about the size of a desk calculator containing 20 integrators, each with an accuracy of 1 part in 250,000. (Litton Industries, Inc.)



February 15



March 1



March 15

Bridged-T Circuits for Combining Transmitters (p 88) Methods of using bridged-T networks and combining transmitter circuits. (Russian Translation)

Strain Gages (p 90) Types of resistor strain gages and their uses. (Abstract)

Milliwattmeter for Microwaves (p 92) Direct measurement of power from 10 to 100 milliwatts at centimeter wave lengths using the differential air thermometer principle. (Abstract)

What the Russians are Writing (p 94) Annotated table of contents of Radiotekhnika, August 1955. (Russian Translation)

February 1

Preferred Circuits (p 20) A description of a few of the NBS preferred circuits including regulated power supplies, video circuits, p-r-f generators, pulse frequency dividers, delay circuits, and audio circuits.

Mechanical Microwave Phase Indicator (p 24) Describing a mechanical device to be attached to a traveling probe permitting direct readings of relative phase in terms of guide wavelengths. (Sage Laboratories, Inc.)

FCC Rules Against Spurious Radiation, by Albert Warren (p 26) A series of FCC regulations going into effect on radiation interference in television, FM receivers, and so called incidental devices.

Electronic Oven (p 28) A home version of microwave cooking equipment described in this "Design Forum." (Tappan Stove Co.)

Corrugated JAN Shield Insert (p 30) This corrugated insert for JAN shields increases reliability by reducing bulb temperature of miniature tubes over 100°C. (Atlas E.E. Corp.)

Miniature Connectors, by L. Baird (p 32) A survey of miniature and sub-miniature connectors including connectors having up to 208 contacts.

Cold Cathode Decade Counter (p 36) Counting at speeds to 30kc or switching at relatively high currents can be performed with this single ended cold cathode unidirectional gas tube. (International Standard Trading Corp.)

Tuners Join "Bookshelf" Amplifiers (p 38) A survey of recent tuner preamplifier-amplifier combinations designed for book shelf type mounting. This article discusses a representative group of these units. A comparison table of tube uses demonstrates their different approaches in circuit design.

Sweep Generator Applications (p 80) Several little known important applications of sweep generators. (Abstract)

Dielectric Amplifiers (p 82) An experimental audio frequency amplifier operating at a bias frequency on the order of 5Mc. (Russian Translation)

February 15

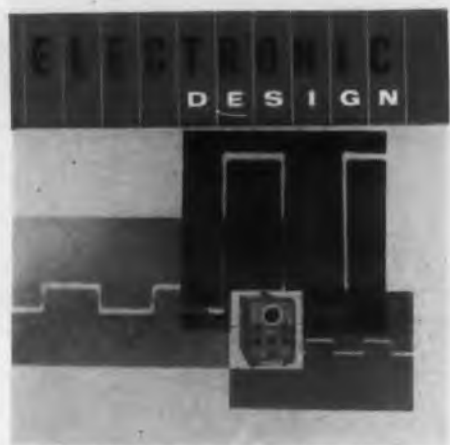
Designing Capacity Coupled Transformers, by G. Wilner (p 26) How to design capacity-coupled transformers in which transfer characteristics can be closely predicted. Several nomographs are included.

Low-Cost Mercury Batteries (p 30) New mercury cells designed to be stacked and low in cost because automatic fabrication and assembly methods are used. (P. R. Mallory and Co.)

Printed Microwave Antennas, by J. A. McDonough and R. G. Malech (p 32) A progress report on the design of flush-mounted printed aircraft antennas.

Human Engineered Comparison Bridge (p 34) Instrument styling which considered the human operator in every aspect. (Electro Measurement, Inc.)

Miniature High-Voltage Regulator (p 36) Miniaturization of regulated voltage supplies using a new pentode regulator tube. (National Union Electric Co.)



April 1

Transistorized Regulated Power Supplies, by H. R. Lowry (p 38) A Background for Designers article discussing the three basic types of voltage regulator circuits that can be built using transistors.

Precision Pot With Spring Contact Taps (p 42) A new precious metal spring contact assures dependable contacts without objectionable linearity distortion at the tap. (Gamewell Co.)

Miniature-Tube Tuning Eye (p 44) A German imported electronic-ray tuning indicator that saves space, requires no special mounting hardware, has high sensitivity, side of tube viewing, and low cost. (International Standard Trading Corp.)

Liquid Filament Transformer (p 46) Corona problems are minimized with this high voltage filament transformer using Askarel insulating liquids and a wet process porcelain high voltage bushing. (Magnatran Inc.)

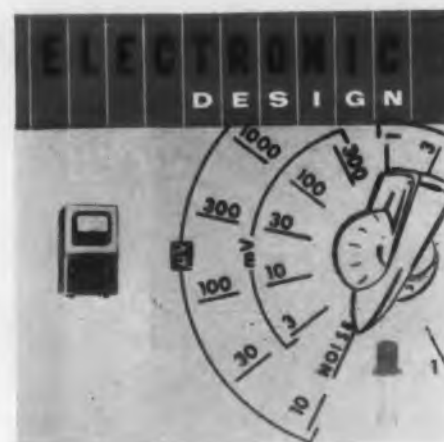
Subminiature Variable Capacitor (p 48) A two section subminiature variable capacitor featuring high capacity in a small package. It is ideally suited for applications involving transistorized superhetrodyne receivers. (Lafayette Radio)

Temperature-Aging Nomographs, by S. A. Davis (p 50) Estimates of the life of motors as a function of the temperatures at which they will be operated can be obtained from the two nomographs presented in this article.

Sources of Standards, by S. H. Hubelbank (p 52) This article tells who publishes specs and standards. The organization, its address, and its activities in standardization are briefly described.

Reading Russian Schematics (p 116) A few basic symbols and tube designations from which an American reader can extract a considerable amount of information from Russian electronic periodicals without actually knowing the language. (Russian Translation)

What the Russians are Writing (p 118) Annotated tables of contents of recent Soviet journals that publish papers on electronics circuit design and behavior. (Russian Translation)



April 15

March 1

Designing UHF Scatter Transmission Systems, by M. I. Jacob and S. E. Vest (p 20) This article presents data to determine scatter transmission performance in terms of signal attenuations, fading limits, and bandwidth capability as well as practical antenna sizes for maximum gain and diversity considerations.

Push-Button Transconductance Tester (p 24) A color coded push-button tester which does not require patch cords to check tube transconductance. (New London Instrument Co.)

Liquid-Cooled Germanium Rectifier (p 26) Power dissipation up to 30w may be obtained with this liquid-cooled germanium power rectifier, which also features small size, high efficiency, and negligible aging effects. (International Rectifier Corp.)

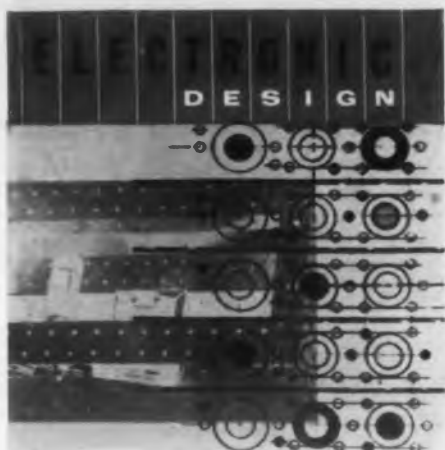
Fail-Safe Monitoring, by W. G. Rowell (p 28) A simple fail-safe monitoring circuit that periodically challenges an operating system to prove that it is functioning properly.

Transistorized Regulated Power Supplies—II, by H. R. Lowry (p 32) A discussion of a third type of voltage regulated circuit using transistors. Emitter-follower type shunt and series feedback circuits were discussed in Part I, (ELECTRONIC DESIGN, February 15, 1956)

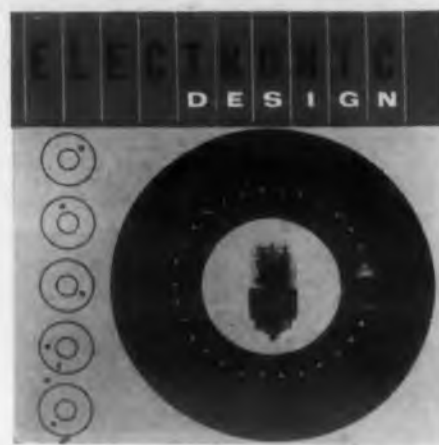
Teflon Coaxial Cables (p 36) Higher temperature and greater power may be handled by Teflon-dielectric r-f cables than similar sized polyethylene transmission lines. (American Phenolic Corp.)

Broad-Band Noise Source (p 38) Design of an efficient broad-band helix coupler has resulted in a gas discharge noise generator which produces 15db output over a range of 200 to 2300Mc. A generator can also be used as an electrically switchable attenuator. (Airborne Instruments Laboratories Inc.)

Telemetry Systems (p 70) Describing an amplitude pulse and frequency modulated telemetry system developed at the Institute of Automation and Remote Control of the USSR Academy of Sciences. (Russian Translation)



May 1



May 15

What the Russians are Writing (p 72) A review of a Russian book concerned with mathematical analog computing machines. A review of several technical articles from Russian periodicals. (Russian Translation)

Measuring Loudspeaker Distortion (p 74) A method of measuring non linear distortion in loud speakers employing modulation of an audio frequency with an infrasonic signal. (Russian Translation)

Diffused Based Transistors (p 76) Both germanium junction type and silicon N-P-N transistors have been produced by the diffusing impurities. (Abstract)

Designing Equipment to Fit the User (p 78) Objectives in designing equipment are to maximize performance of the user and to optimize the return on the investment. (Abstract)

March 15

Designing a UHF TV Sweep Frequency Generator, by H. F. Hanthorn (p 24) Some of the problems experienced in the development of an oscillator and tuning unit and a system for frequency-modulating the generated UHF voltage described in detail.

Toggle-Switch Programmed Computer (p 28) Toggle switches and calibrated dials on the problem board eliminate the use of connecting cables and patch cords in setting up problems on this general purpose analog computer. (Weber Aircraft Corp.)

Electron Tube Information Service (p 30) Questions pertaining to information about any particular tube type, with electrical characteristics, bulb sizes or base configurations that fall within particular ranges, and domestic tubes that can be substituted for unavailable foreign tubes can be answered by the Electronic Tube Section, National Bureau of Standards.

Miniature Wire-Wound Precision Resistors (p 32) Primarily designed for printed circuit applications, these wire-wound units are extremely small for their wattage ratings and the range of resistance values obtainable. (Reon Resistor Corp.)

Temperature Effects on V-R Tube Operation, by Earl J. Handley (p 34) How to determine the temperature which will yield the best performance from any given V-R tube type. Charts and a table illustrate temperature characteristics of V-R tubes.

Sensitive Heat Flow Transducer (p 38) More accurate measurement of temperature distribution of heat flow through a surface is achieved by using a small thermocouple disc transducer which has a low thermal resistance. (National Instrument Laboratories Inc.)

Applying Tape Resistors in Design, by H. R. Hanson (p 40) Tape resistors have good resistance to shock and vibration, withstand high operating temperatures and are highly reliable. To achieve these benefits it is necessary for the designer to know when and how to use them to advantage.

Ultra-Vernier Capacitor (p 44) Designed principally for computer applications, these vernier capacitors exhibit extremely high order stability coupled with ease and accuracy of capacity adjustment. (Balco Research Laboratories Inc.)

Angle Analyzer (p 46) Exact angle setting of shafts potentiometers, resolvers and switches can be quickly measured with this device known as the "Anglyzer." (Waters Mfg. Co. Inc.)

Rectilinear Recording Milliammeter (p 48) Direct rectilinear ink recording is accomplished with a galvanometer-actuated instrument. (Texas Instruments Inc.)

Electro-Mechanical Cam, by D. Shaw and O. F. Shaper (p 50) Combining mechanical and electrical principles, the electrical cam described supplies angular shaft displacement as a function of time. By using a rotating eccentric contact, proportional control is achieved with basically an on-off system.

Sensitive Electrometer VTVM (p 52) Ultra-high input impedance and sensitivity of 800 microvolts are features of this battery operated d-c VTVM. (Keithley Instruments Inc.)

Printed Wiring Amplifier (p 54) These compact audio amplifiers are desirable for use in phonographs, intercoms, tape recorders, and other units requiring low power audio amplification. (Photocircuits Corp.)

What the Russian are Writing, by J. G. Adashko (p 168) Reviews of several technical articles from recent Russian periodicals. (Russian Translation)

Electronic Acoustic Transducer (p 172) Sound energy modulates secondary electrons emitted from the target in this cathode-ray electronic acoustic converter. (Russian Translation)



June 1

Applying Electron Tubes (p 174) Electronic equipment designers may determine the adequacy of a specific tube for a given circuit by considering separate tube property categories. (Abstract)

High Voltage from Dry Batteries (p 178) Transistors can be used in the circuit shown to provide high voltage from low voltage dry batteries for oscilloscope tubes and other low current high voltage requirements. (Abstract)

Atomic Energy Instrumentation (p 180) Seven broad classifications of operations in production of atomic power are reactors, feed material, chemical separations, gaseous diffusion, waste disposal, health physics and industrial use of isotopes. (Abstract)

April 1

Die Casting Parts for Electronic Devices, by E. F. Hannon (p 20) To the designer of electronic and electrical parts, die casting may offer advantages of low unit cost, assembly ease, freedom of design detail, weight reduction, and finishing flexibility.

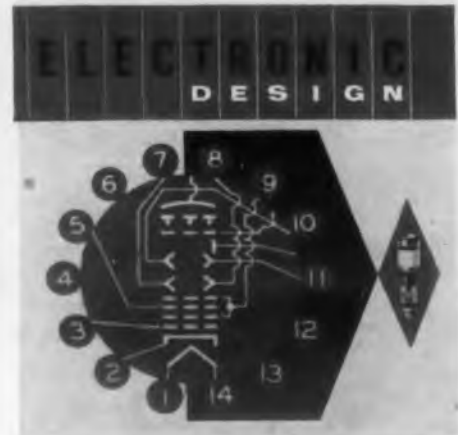
Square Wave Generator (p 24) Signals from the 75-ohm output of this square wave generator have a maximum rise time of 0.02usec from 1cy to 1Mc and are sufficiently fast to test video amplifier response to about 20Mc or for high-speed triggering. (Hewlett Packard Co.)

High Power from Miniature Tubes, by J. T. Revis (p 26) Because required power could be obtained from miniature tubes, this power amplifier circuit increased power efficiency 47% thus reducing circuit heat produced for a given power output.

X-Band Torque Wattmeter (p 28) Torque operated, this feed through microwave wattmeter is an absolute standard intended to replace cumbersome water calorimeters. (Marconi Instruments)

Hybrid Parameters for Grounded Emitter Amplifiers with Feedback, by R. L. Riddle (p 30) This article presents the equations necessary to compute the performance of a grounded emitter stage with shunt or series feedback.

Circular Polarizer Improves Viewing, by W. A. Shurcliff (p 32) Reflections from radar screens, cathode ray oscilloscope tubes, and from instrument dials are eliminated by using a circular polarizer.



June 15

Autotransformer for Power Supply (p 34) A low-priced power supply using an autotransformer instead of a conventional transformer with a high voltage secondary, for use in the power supply of a television receiver. (United Scientific Labs. Inc.)

Accessible Modular Construction, by A. T. Steinkamp (p 36) Accessible Modular Construction is a packaging method for electronic equipment which expedites servicing and maintenance. Its test points are conveniently accessible for localizing troubles and subassemblies are readily replaceable for quick repairs.

What the Russians are Writing (p 76) A review of several technical articles from recent Russian periodicals. (Russian Translations)

Shunt Antenna Radiators (p 78) Shunt radiators used for meter and decimeter waves as well as for short and medium waves are described. (Russian Translation)

Automatic Factory Components (p 80) A discussion of steps in standardizing on building blocks that will make up automatic assemblies in automatic factories. (Abstract)

Computer Operational Equations (p 82) Computing circuits of analog computers can be replaced by symbolic equations provided appropriate notation is used. (Abstract)

April 15

Construction and Use of Cathode Follower Design Charts, by N. Sokal (p 26) Typical uses of universal cathode follower design charts and how to construct them.

Ultra-Sensitive A-C Transistor Voltmeter (p 30) Providing the advantages of battery operation, this VTVM has a sensitivity of 2 μ v. Because of the low current drain of transistors, minimum battery life is 200hrs. (Millivac Instrument Co.)

Corona Testing, by T. F. Verbon (p 32) A corona test set giving an accurate measurement of the corona being generated at any test voltage, and accurately measuring the voltage breakdown point of a component. It also determines the frequency at which the maximum corona noise is generated to aid in designing noise filters.

Miniature Indicators (p 34) Indicator lamps described here occupy half to 2/3 less volume than other assemblies heretofore available. (Circon Component Co.)

Testing Selenium Rectifier, by E. L. Pagano (p 36) Described here are some effective test procedures that can be performed to determine the quality of the selenium rectifier.

Miniature Servo Motor (p 40) This servo motor is only 1/2" x 1" in diam and is believed to be the shortest made. (John Oster Mfg. Co.)

Probe Tip Design (p 42) This newly developed probe tip includes a nylon body which has toughness, combined with a thin wall to aid in reaching otherwise inaccessible test points. (Tektronics Inc.)

Seven Design Tips for Printed Circuit Layout, by A. E. Linden (p 44) Seven basic design tips are given for laying out a printed circuit board to facilitate low cost, automatic assembly, functional operation, neat appearance, and easier maintenance.

Up and Down Decade Counter (p 48) Using a novel internal gating system, this decade counter can either add or subtract electrical pulses. (Controller Instrument Co.)

Miniature Terminal Strip for P-C Work (p 50) Solderless taper tabs can be connected into one side of these miniature terminal strips designed for printed-circuit computer applications. (DeJur-Amsco)

Printed Circuit Fastener (p 52) Especially developed to hold printed circuit boards in place in assembly, the fastener described will hold against approximately 10 lbs pull or force. (Camlock Fastener Corp.)

Signal Generating Probe (p 54) Making use of a neon-tube relaxation oscillator, this variable-frequency audio generator as described in a "Design Forum" article is self contained in a standard 3/8" diameter test probe. (Talley Electronic Development Corp.)

What the Russians Are Writing (p 128) A review of several technical articles from recent Russian periodicals including a comparison of theories of vacuum tube and transistor amplifiers and the possibilities of generalizing these theories. (Russian Translation)

Ferrite Isolators (p 130) Commercial ferrite rotation-type isolators are available for frequencies from 5.4 to 17kmc with power handling capacities up to 250w. A table included lists models and characteristics of commercial ferrite isolators. (Abstract)

May 1

Photoelectric Analog-to-Digital Converters, by A. L. Mitchell (p 20) Photoelectric converters are new and different tools for indicating shaft position or more generally for measuring angles in digital form.

Multi-turn 1.0μsec Delay Line (p 24) Describing a continuously variable multi-turn delay line with high accuracy and resolution. (Helipot Corp.)

Designing Cascode Amplifiers with g-Curves, by K. A. Pullen Jr., (p 26) Conductance curve techniques described are an aid determining proper operation of cascode amplifiers.

Fixed Heater Current Source for Testing Series-String Tubes, by W. Drummeter and R. E. Salzman (p 28) Several methods are described providing an exact current in a tube tester for testing series string tubes.

Modular Electronic Hardware (p 30) New prefabricated mechanical and electrical building blocks described here reduce the time between breadboard models and regular production models. (Circle Dot Mfg. Co.)

Plug-In Printed Circuits (p 32) How plug-in printed circuit boards save valuable space and improve functional operation are described in this "Design Forum" article. (Ralph M. Parsons Co.)

Flat Cables (p 34) A new ribbon-type cable offers advantages of minimum space requirements, ability to withstand extremes of temperature, and good high frequency characteristics. (New Products Co.)

Computer Developments (p 36) A report on programming computers, coding systems, and other trends associated with computers and their applications.

Printed Circuits from Powder Resist (p 38) Describing a new process Xerography, a fast dry electrostatic method of copying using a powder image. Previously used in office and graphic arts reproductions, the method is now used for the preparation of printed circuits for etching.

Microwave Antenna House of Extruded Plastic (p 76) Describing the design of an acrylic penthouse structure perched atop a 14-story equipment building of the Southern New England Telephone Company. (Abstract)

What the Russians are Writing (p 78) A review of several technical articles from recent Russian periodicals including high frequency wide-band transformers. (Russian Translation)

New Russian Books (p 82) Reviews of recent Russian technical books on subjects including non-linearity, magnetrons and high frequency compensations. (Russian Translation)

May 15

Decade Tube Counter Circuitry, by John Adams (p 26) Design information and circuit suggestions for getting the most effective performance from decade counter tubes.

Transistorized Volt-Ohmmeter (p 30) A general purpose transistorized volt-ohmmeter with a sensitivity of 200,000 ohms/v d-c. Battery life is from 300 to 400 hours. (New London Instrument Co.)

What Good Are Patents? by R. C. Miles (p 32) A guide to the engineer's understanding of patent protection, what to patent, when to patent, and infringement considerations.

Modularized Portable (p 36) Modular construction in a portable radio permits six tubes to be placed inside a cabinet designed for five. (Motorola)

Miniature Clutch Brakes (p 40) Used in the design of servo systems, these clutch brakes feature small size and light weight. (A. J. Thompson Co.)

Build a Volt Box, by O. M. Salati (p 42) Describing the construction of a portable variable-potential source for checking operations on an analog computer.

Interchangeability List of MIL Preferred Tubes (p 46) A list of military type numbers of rugged versions of well known commercial tubes. (New London Instrument Co.)

New Inverse Pulse Recovery Test Method, by N. DeWolf (p 48) A new test method for accurate testing of computer clamping and logic matrix semiconductor components.

Electronic Circuit Synthesizer (p 50) Quick, easy, solderless circuit changes are possible using this device. It can also serve as a problem board for computers and for testing relay systems.

Radar Doppler Frequency Nomograph, by G. T. Baker (p 52) A nomograph for finding either transmitted wavelength, radial velocity or Doppler frequency when the other two are known.

Transistor Circuit Developments (p 56) Recent developments and trends in the transmitter field noted from the 1956 Transistor Circuits Conference.

What The Russians Are Writing, by G. Adashko (p 132) A review of some recent technical articles that appeared in recent Russian periodicals. (Russian Translation)

Soviet "K" Stabilizer (p 134) Several methods the Russians have been using to stabilize supply voltage. (Russian Translation)

Constant Temperature Oven (p 136) Description of a compact oven for stabilizing operation of a quartz crystal. (Abstract)

Stable RF Voltmeters (p 138) An r-f voltmeter, known as an attenuator-thermoelement maintains its calibration for over a year. (Abstract)

June 1

Effective Capacitance in Modulated Power Amplifiers, by R. Lee (p 22) Influence of incidental capacitance upon the performance of high-level amplitude-modulated amplifiers.

Automatic Sweep Synchronizer (p 26) A device that maintains a predetermined number of cycles of a test wave on an oscilloscope screen over a wide frequency range. (Chadwick-Helmuth Co.)

Decade Counter Tube Circuitry—II, by J. Adams (p 28) A complete counter circuit for applications involving high-speed counting.

Etched Board Test Points, by Neal Hess (p 30) Using printed eyelets as test points on printed circuit boards.

Jiffy Cabinet Design (p 32) Using standard aluminum pieces for designing and producing cabinets quickly and economically. (Alfred Imhof, Ltd, London)

Kelvin-Varley Potentiometer (p 34) Precise voltages may be picked off at points of integral Kelvin-Varley voltage dividers and potentiometers. (Servonics, Inc.)

Factors Affecting Resistor Tolerances, by Floyd A. Paul (p 36) Handling, storage, installation and operating considerations in the selection of resistors.

What the Russians are Writing, by J. George Adashko (p 82) A review of some recent technical articles that have appeared in recent Russian periodicals. (Russian Translation)

Operations Research (p 86) Discussion of the scope of operations research. (Abstract)

June 15

What Type of Degenerative Feedback for Transistors, by R. B. Hurley (p 22) A discussion of negative feedback as applied to transistor amplifiers.

Multi-Oscilloscope (p 26) Grouping of two or more oscilloscope tubes in one relay-rack unit. (Tinker & Razor)

Cathode-Ray Tube Phosphors, by R. G. Millett (p 28) A design analysis to aid in the selection of tubecscreen phosphors.

Charge Storage Tube (p 30) Storage tube that may be used in a number of technical-data and business-information processing systems. (Radio Corp. of America)

Specifying Toroidal Reactors, by R. E. Edgar (p 32) How to correctly specify toroidal reactors based on the core material.

I.V. Tuner Design, by R.C.A. Eland (p 34) Circuitry and design features contributing to the lower cost and improved performance of this tuner.

Coaxial Impedance Matcher (p 38) An impedance matching coaxial E-H Tuner used for effecting impedance transformation in coaxial line circuits. (Jasik Laboratories)

New Program Board (p 40) Shielded patch and program board made of nylon blocks. (Aircraft-Marine Products, Inc.)

Binary Conversion for A-D Converters, by Ira L. Resnick (p 42) A discussion of the use of shift registers in analog-to-digital conversion

Automatic Functional Tester (p 46) A robot tester for circuit testing in a predetermined sequence. (Dit-McO, Inc.)

What the Russians are Writing (p 122) A review of recent technical articles that have appeared in recent Russian periodicals. (Russian Translation)

Centimeter Waves by Means of Sparks (p 124) How microwaves may be generated using a spark discharge. (Russian Translation)

Analog to Digital Converters (p 126) A discussion of various analog-to-digital converter systems and the advantages and disadvantages of each. (Abstract)

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Weston Electrical Instrument Co.	27
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Dual Directional Couplers

for reflectometer measurements on coaxial systems



4 all-new couplers!

**Complete coverage,
216 to 4,000 MC**

Ideal for power measurements

Flat response, high directivity

**Low SWR, wide band
performance**

These new *-hp-* couplers save your time by making possible, for the first time, convenient reflectometer measurements on coaxial antennas, transceivers, counter-measures and TV equipment, etc. Each unit centers on a major band but offers 2:1 frequency coverage. Directivity is high, units handle powers to 50 watts cw, and insertion loss is low for permanent installation. The couplers can be used to measure forward or reverse power or to adjust system flatness.

-hp- 760 series couplers are compact, sturdy, and precision built of highly heat stable materials for long-term accuracy.

SPECIFICATIONS

	-hp- 764D	-hp- 765D	-hp- 766D	-hp- 767D
Frequency Range:	216 to 450 MC	450 to 940 MC	940 to 1,900 MC	1,900 to 4,000 MC
Coupling Attenuation:	20 db	20 db	20 db	20 db
Coupling Accuracy:	±1 db	±1 db	±1 db	±1 db
Max. Prim. Line SWR:	1.10	1.15	1.20	1.25
Max. Second. Line SWR:	1.10	1.20	1.30	1.35
Minimum Directivity:	30 db	30 db	26 db	26 db
Prim. Line. Insert. Loss:	Approx. 0.15 db	Approx. 0.20 db	Approx. 0.25 db	Approx. 0.35 db
Price:	\$125.00	\$125.00	\$125.00	\$125.00

All models: Power handling capacity 50 watts CW or 10 Kw peak. Primary Line Connectors: Type N, Male & Female. Secondary Line Connectors: Type N, Female. Reflectometer Detectors: 764D/765D take -hp- 476A; 766D/767D take -hp- 420B. Size all units: 9" long; weight 2 lbs. Prices f.o.b. factory. Data subject to change without notice.

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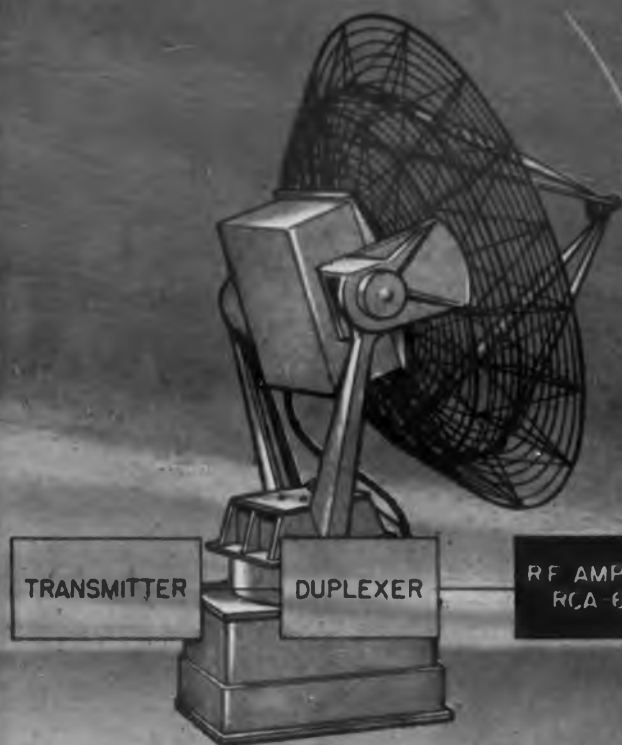


highest quality, value, complete coverage

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FIRST COMMERCIALY AVAILABLE

LOW-NOISE TRAVELING-WAVE TUBE



TRANSMITTER

DUPLEXER

RF AMPLIFIER
RCA-6861

RECEIVER

P-P-1

with av. noise figure of 6.5 db
over entire 2700-3500 Mc band

- Increases S-band receiver sensitivity
- eliminates crystal "burnouts"

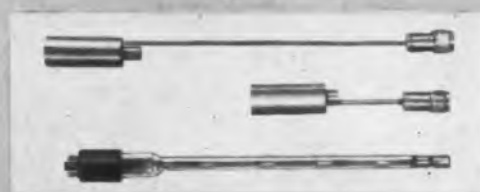
Now in production, RCA-6861 is a major advance in electron-tube design for microwave receivers. It enables—for the first time—the practical application of low-level rf-amplifier stages in radar, scatter-propagation, and other microwave receivers, and if-amplifier stages for millimeter-wave receivers.

The unusually low noise figure of 6.5 db is obtained by the use of an RCA-designed special type of electron gun which deamplifies noise generated in the electron beam.

Sales information on sample units or quantity deliveries is available. Contact your RCA Representative at the RCA District Office nearest you.



Patterns show signal-to-noise ratio at input to S-band receiver's crystal detector with and without a stage of rf amplification. Utilizing RCA-designed-and-developed type 6861 Traveling-Wave Tube, high signal-to-noise ratio and extended range are obtained. In addition, crystal "burnouts" caused by TR-tube leakage are eliminated by the isolation afforded by the rf stage.



Glass portion of RCA-6861 is enclosed with rf-input and rf-output transducers in tubular metal capsule. Transducers are factory-set for optimum tube performance; require no adjustment in the field. Capsule has terminals which fit the standard octal socket.

RCA-6861 DATA	
Heater Voltage	5.0 ±5% volts
Collector Voltage	400 volts
Collector Current	150 μ a max.
Magnetic Field*	525 gauss
Noise Figure	6.5 db
Gain	25 db
Frequency Range	2700 to 3500 Mc

*field supplied by RCA solenoid Dev. No. 1-2006, or equivalent.

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WEST: Raymond 3-8361
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Los Angeles 22, Calif.

For technical data on RCA-6861, write RCA, Commercial Engineering, Section G18Q2, Harrison, N.J.

HAYDEN PUBLISHING COMPANY, INC.
19 East 62nd Street, New York 21, N. Y.

ELECTRONIC
DESIGN



RADIO CORPORATION of AMERICA
TUBE DIVISION
HARRISON, N.J.

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